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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

493rd MEETING

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THURSDAY, JUNE 6, 2002

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ROCKVILLE, MARYLAND

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The ACRS met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B3, 11545 Rockville Pike, at 8:30 a.m., Dr. George E. Apostolakis, Chairman, presiding.

COMMITTEE MEMBERS PRESENT:

GEORGE E. APOSTOLAKIS	Chairman
MARIO V. BONACA	Vice Chairman
F. PETER FORD	Member
GRAHAM M. LEITCH	Member
DANA A. POWERS	Member
VICTOR H. RANSOM	Member
STEPHEN L. ROSEN	Member
WILLIAM J. SHACK	Member
JOHN D. SIEBER	Member
GRAHAM B. WALLIS	Member

ACRS STAFF PRESENT:

JOHN T. LARKINS	Executive Director
SHER BAHADUR	Associate Director
SAM DURAISWAMY	Technical Assistant
TIMOTHY KOBETZ	Cognizant Engineer
HOWARD J. LARSON	Special Assistant
MAGGALEAN W. WESTON	Staff Engineer

NRC STAFF PRESENT:

PATRICK BARANOWSKY	NRR
BILL BASEMAN	NRR
STEVE BLOUR	NRR
THOMAS BOYCE	NRR
ART BUSLIK	NRR
JOSE CALVO	NRR
CYNTHIA CARPENTER	NRR
KEN CHANG	NRR
STEPHANIE COFFIN	NRR
MARY DROUIN	NRR
RON FRAHM	NRR
MIKE FRANOVICH	NRR
D.E. HICKMAN	NRR
ALLEN HISER	NRR
MICHAEL JOHNSON	NRR
IAN JUNG	NRR
PETER KANS	NRR

NRC STAFF PRESENT:

P.T. KUN	NRR
ANDREA LEE	NRR
SAM LEE	NRR
W. LIU	NRR
TONY MARKLEY	NRR
MICHAEL MARSHALL	NRR
MIKE MAYFIELD	NRR
SCOTT NEWBERRY	NRR
ALLEN NOTAFRANCESCO	NRR
BOB PALLA	NRR
RICHARD PUDLEY	NRR
JACK ROSENTHAL	NRR
MARK RUBIN	NRR
MARK SATURIUS	NRR
PAUL SHAMANSKI	NRR
MIKE SNODDERLY	NRR
DWIGHT SNOWBERGER	NRR
ASHOK THADANI	NRR
JOHN THOMPSON	NRR
KEITH WICHMAN	NRR
CHARLES ADER	RES
SATISH AGGARWAL	RES
NILESH CHOKSHI	RES
FAROUK ELTAWILA	RES

NRC STAFF PRESENT:

SIDNEY FELD	RES
ED HACKETT	RES
HOSSEIN HAMZEHEE	RES
ASIMIOS MALLIAKOS	RES
JOHN RIDGEBY	RES
ALAN RUBIN	RES
HAROLD VANDERMOLN	RES
JACK GROBE	NAC/Riii
ALAN LEVIN	OCM
SUSAN UTTAL	OGC

ALSO PRESENT:

MIKE BARRETT
CHARLES BRINKMAN
BOB BRYAN
KURT COZENS
DAVID DELLANO
STEVE EIDY
STEPHEN FYFITCH
PAUL GUNTER
ANN HARRIS
TOM HENRY
JOHN HINKLING
PHIL HOLZMAN
BILL HORIN

ALSO PRESENT:

DANIEL HORNER
TOM HOUGHTON
STEVE HUNT
ROGER HUSTON
DICK LABOTT
JOHN LEHNER
DAVID LOCKBAUM
STEVE LOEHLEIN
ALEX MARLION
PATRICK McCLOSKEY
MARK McLAUGHLIN
JIM MEYER
JIM POWERS
DEANN RALEIGH
PETE RICCARDELLA
JACK ROE
JOHN RYCYNA
ROBERT SCHRAUDER
KEVEIN SPENCER
TUNG TSE TSENG
BOB YOUNGBLOOD

I N D E X

P R O C E E D I N G S

8:31 a.m.

CHAIRMAN APOSTOLAKIS: The meeting will now come to order. This is the first day of the 493rd meeting of the Advisory Committee on Reactor Safeguards. During today's meeting, the Committee will consider the following: CRDM Cracking of Vessel Head Penetrations and Vessel Head Degradation; Technical Assessment Generic Safety Issue (GSI)-189, "Susceptibility of Ice Condenser and Mark III Containments to Early Failure from Hydrogen Combustion During a Severe Accident"; Technical Assessment of GSI-168, Environmental Chylifaction of Low-Voltage Instrumentation and Control Cables; Development of Reliability/Availability Performance Indicators and Industry Trends; Technical and Policy Issues Related to Advanced Reactors; and Proposed ACRS Reports.

This meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act. Mr. John T. Larkins is a designated federal official for the initial portion of the meeting.

We have received no written comments from members of the public regarding today's sessions. We have received requests from Ms. Ann Harris, a member of the public, and David Lockbaum, Union of Concern Scientist for time to make oral statements regarding GSI-189.

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

I don't have any special comments. Do any of you Members want to say anything before we start?

MR. LARKINS: Mr. Chairman?

CHAIRMAN APOSTOLAKIS: Yes.

MR. LARKINS: I think we also received a letter from Mr. Ken Bergeron regarding GSI.

CHAIRMAN APOSTOLAKIS: Yes.

MR. LARKINS: 189.

CHAIRMAN APOSTOLAKIS: Yes, we did.

MR. LARKINS: Which we will enter into the record.

MEMBER KRESS: And I understand Mr. Lockbaum will speak to that letter.

CHAIRMAN APOSTOLAKIS: Yes. The first item on the agenda is the CRDM Cracking of Vessel Head Penetrations and Vessel Head Degradation. The cognizant member is Dr. Ford. Please.

MEMBER FORD: Thank you. The Metallurgy and Plant Operations Subcommittees had an extended meeting being briefed on the CDRM housing cracking and pressure vessel head degradation issues. We purposefully did not dwell on safety culture and reactor oversight process issues since these are being dealt with separately.

All the ACRS Members, apart from Dr. Powers, were present at the Subcommittee meeting. The staff have requested a letter from us, commenting on the technical aspects of these degradation programs.

I'd like to proceed with the first presentation by Jim Powers, I understand from FENOC.

MEMBER POWERS: Good morning. I'm Jim Powers, the Director of Engineering for First Energy at the Davis-Besse Nuclear Plant and we're going to review the -- briefly, the presentation that we did yesterday to the Subcommittee and I brought with me once again Mark McLaughlin, who is our field team lead for work on the reactor head at Davis-Besse; Bob Schrauder who is the Director of Life Cycle Management for First Energy. He's responsible for the procuring and installing a replacement head from the Midland Plant which is now our preferred approach to recovering the head at Davis-Besse. And Steve

Loehlein will talk briefly on the root cause, any updates and questions there may be on that. So Mark, why don't you go ahead.

MR. McLAUGHLIN: All right, thank you, Jim. Since you all have seen these pictures, I will be brief. Next slide, please.

(Slide change.)

MR. McLAUGHLIN: Keep on going. Next one. Okay, this first picture is abrasive water jet cutting machine that we used. This particular picture is on a one to the mockups. We did mockup this process twice prior to performing it on the reactor pressure vessel head at Davis-Besse.

Next slide.

(Slide change.)

MR. McLAUGHLIN: This next picture is a picture of the cutout on the actual head at Davis-Besse.

Next slide.

(Slide change.)

MR. McLAUGHLIN: This is a picture underneath the head at Davis-Besse using a remote camera and it's the same cutout.

Next slide, please.

(Slide change.)

MR. McLAUGHLIN: This is a picture of the cavity that has been removed and I'll talk about on the next slide. We had three phases of samples that we're going to do analyses for. Phase 1 was boron samples from various location son the head. Those -- we do have a draft report with the results of those samples. Just briefly, we did five boron, iron and lithium which is to be expected, as well as nickel and chromium in those samples.

Phase 2 samples --

MEMBER SHACK: Excuse me. You're looking at analysis techniques that will tell you more than just the chemical composition. We're going to know the actual bores?

MR. McLAUGHLIN: That's correct, yes. We do have -- they had the forms.

MEMBER SHACK: Right, you're not a mineralogy, so --

MR. McLAUGHLIN: That's correct.

MEMBER SHACK: That's not your concern, but that information will be available?

MR. McLAUGHLIN: Yes, it will. We would expect to have that report issued to the staff within the next two weeks.

Phase 2 will be essentially the same type of analysis. The Phase 2 has the samples that were taken when we removed nozzle number 2, so there should be some boron from the annular space and should hopefully that will help us with some of the chemistry questions that we have in the annular space.

And then Phase 3 is the actual nozzles 2 and 3 that were removed as well as the cavity and we're working with the staff on determining exactly which tests to perform on that. Right now, all three of these samples are in Lynchburg, Virginia and we have meetings scheduled within the next two weeks with the staff to go down there and discuss what type of analysis because the next step will be -- will require some destruction of the samples.

MEMBER WALLIS: It seems to me that there's a lot of clue in the shape of the cavity as to what happened. I hope you're really careful to get all the information you possibly can out of it before it is destroyed or turned into something else.

MR. McLAUGHLIN: What we're doing is we're going to take extensive photographs of the cavity in its present condition, as well as take a lot of measurements so we can gain as much information prior to doing any destruction of the sample.

MEMBER WALLIS: I would suggest that

people some hypotheses before they start doing this so they know what they're looking for, so they know what's required in order to verify or challenge the hypotheses.

MR. LOEHLEIN: Yes, we in root cause have been advising from several months ago what sorts of things we were looking for that might give us evidence of different types of mechanisms, whether they be flow induced, impingement, corrosion, what have you.

In this cavity, we were unable to in situ take any kind of impression like we were able to do at Nozzle 2. There are areas, a lot to do yet --

MEMBER WALLIS: You can take impressions of that.

MR. LOEHLEIN: We couldn't while it was on the head.

MEMBER WALLIS: You can now though.

MR. LOEHLEIN: Now we can do a lot of things and Tod Plune is back at the site that's working on the lead as far as what we do with these samples.

MEMBER WALLIS: Okay.

MR. McLAUGHLIN: Yes, we also have a person who will be down there in Lynchburg with us, with the staff is Mr. Steve Fyritch. He's on the Root

Cause Team for the Davis-Besse Root Cause. So we're keeping the root cause personnel tied into this process.

And this picture is a picture of the actual cavity. You can see into the underhung area after it was removed. And then the last picture shows the side view of the sample that was removed. You can see the J-groove weld around Nozzle 11 and the last time we were here there was some discussion about maybe a possible detachment or corrosion between the stainless steel liner and the base material. We did perform a visual inspection. We can't do any dye penetrant because the surface is too rough to do that and there was no evidence of any cladding detachment.

That's all I have. If there's any questions -- all right. I'd like to turn it over to Bob Schraider who is the Director of Life Cycle Management for First Energy Nuclear Operating Company. And he's the senior person in charge of head replacement.

MR. SCHRAUDER: Good morning. As Mark and Jim indicated, while we went down the repair path, I in parallel was looking at the ability to procure, transport and install a replacement reactor vessel head at Davis-Besse.

Our search included looking at accelerating a schedule for manufacture of a brand new head for Davis-Besse and also looking at existing heads in the industry.

We were unable to significantly accelerate the schedule for our new head which is scheduled to be delivered during the first quarter of 2004. We did find two compatible heads with Davis-Besse existing in the industry. One was at a checkdown plant in California, the Rancho Secho Plant. The other was the unfinished plant up in Midland, Michigan which was also a Babcock & Wilcox design. We quickly narrowed our view down and decided to purchase the Midland head. It had several advantages to us. It was very close to us, one state away and it was not contaminated, so any work that we had to do on it and transportation was significantly easier with an uncontaminated head than it was a contaminated one.

I'll talk a little bit about the similarities on this head to the Davis-Besse design. It was fabricated by Babcock and Wilcox to the same code and addenda as the Davis-Besse reactor vessel head was. We have records on this head, indicating that it was accepted by Consumers Power. And it was signed off by an authorized nuclear inspector as an acceptable ASME component.

We also have records indicating that this head was hydrostatically tested prior to its shipment to the Midland site.

Now our approach to procuring this -- well, one thing I should say is that the Midland Plant was canceled back in the 1980s. Since that time this reactor vessel head has been sitting on the head stand within the containment at the Midland site.

We chose Framatome to work with us because of their expertise, technical expertise and their access to the records on this head. They actually purchased a head from Consumers for us as a basic component. They're compiling the code data package or pulling that out of the records, compiling it for us and they will disposition any nonconformances due to the storage of that head in the containment.

They will also reconcile the Midland head for the design at Midland to the design at Davis-Besse and I'll show those design requirements in just a minute and of course they do have a quality assurance program there at Framatome and they will be doing this in accordance with their quality assurance program, including Part 21 reporting on requirements. Then they will sell that head to First Energy as the component, basic component.

The next slide shows that the material of construction and this head is virtually identical to that of the Davis-Besse design, even that material for the closure head flanges, in fact, the same material has all the same material properties. The design, you see, this head and vessel was designed to the same pressure and temperature as the Davis-Besse design requirement.

We did take a look at the nozzles on this head and the material of those nozzles. They are the same nozzle material as the Davis-Besse with a different heat number and those two heat numbers are identified on this slide. All but one are from a single heat. Neither of these two heats has any industry experience. Their qualities and their yield stress we have found to be in the middle of the range of the heats that have some industry experience.

And of course, the alignment of the control rods is the same on this head as it was for the Davis-Besse design.

This picture shows what's known as the key-way. There are four of these key-ways on the head that precisely align this head to your vessel and each is somewhat custom fit to the vessel. They are in nearly the same position but the times are mils off. There are eight surfaces on these four key-ways, the inner and the outer. Four of those eight surfaces needed to have some slight machining to precisely fit this head to the Davis-Besse head. And the control rod drive mechanism flange indexing, where the control rod drive mechanism comes on to the nozzle has an indexing pin for proper alignment and there are two locations that you can align from on this. The Davis-Besse design is on the opposite one that Midland was set up for and therefore those indexing holes, there's a plug that needs to be taken out of the existing hole on the Midland head and moved to the other side so that we have the proper indexing location for our control rods.

MEMBER KRESS: Is the plug welded in?

MR. SCHRAUDER: No, it's not.

MEMBER KRESS: Just forced in?

MR. SCHRAUDER: That's correct. The other difference on this head is the O-ring design. The O-ring has the groove in the O-ring itself is slightly smaller on the Midland head and that is consistent with the rest of the head, the Davis-Besse had somewhat of a unique difference. We had a .5 inch small diameter in our O-ring. We have analytically shown that the smaller O-ring will seal effectively in the groove in our vessel and of course, we'll test that as we bring this vessel and head up to pressure.

We will manufacture and install new O-rings on to the Midland head.

MEMBER KRESS: How did you assure yourself that the O-rings would seal sufficiently?

MR. SCHRAUDER: We have the precise dimensions of the location of the grooves on the Midland --

MEMBER KRESS: Was it dimensional?

MR. SCHRAUDER: That's correct. And there is a leak off system between those seals that we'll be able to verify that the seals -- we see no problem. We have very good crush on --

MEMBER KRESS: Are those the same seals that were leaking in the regional vessel?

MR. SCHRAUDER: No, those seals, I believe were the control rod drive mechanism.

MEMBER KRESS: That's not the seals you're talking about?

MR. SCHRAUDER: No, this is the head to vessel flange seating surface.

MEMBER KRESS: Okay.

MR. McLAUGHLIN: As a matter of fact, if you want to --

MEMBER KRESS: It would be right here.

MR. McLAUGHLIN: Right here, the O-ring grooves are here.

MEMBER KRESS: That's a big O-ring that goes all the way around?

MR. McLAUGHLIN: That's correct, a set of two of them.

MR. SCHRAUDER: And the gaskets you were talking about are up here.

MEMBER WALLIS: Do those O-rings move once the system is pressurized?

MR. McLAUGHLIN: I suppose they could a little bit. There's clips that hold the O-rings in place. However, the clips are slotted.

MEMBER WALLIS: You're essentially relying on the crush to hold them in place?

MR. McLAUGHLIN: Correct.

MEMBER WALLIS: And that seals -- they're not supposed to move the way the rubber ones do.

MEMBER SIEBER: Not from side to side, but when you pressurize the vessel, it moves a little bit. There's tension in the studs. The compression of the O-ring reduces slightly.

MR. SCHRAUDER: This next pictorial, if you will, is useful in looking at the next few slides that I'll discuss the examinations that we'll do on this head to verify its suitability for use at Davis-Besse.

We're doing three different sets of examinations. One is to supplement the Code Data Package. One is our pre-service inspections and another is just additional, nondestructive exams that we'll do to verify that there's been no deleterious effects due to this long-term storage that this had at the Midland containment.

You see to supplement the code data package we'll be doing visual examinations, looking for any obvious signs and in particularly looking to verify that there are no arc strikes on the head which may indicate unauthorized welding on the head.

We're going to radiograph and actually we've already completed the radiograph of the flange to dome weld. This head, like the Davis-Besse head was forged in two pieces, the dome and then the flange and then there's a large weld on that. We've completed a radiograph on that weld and they've shown it to be a good weld.

We got about a 96 percent coverage due to the lifting lugs that prevented 100 percent radiography on that. We do, however, have records that indicate that there was 100 percent radiograph successfully done on that head in the past.

We do intend to do a radiograph on all the nozzle to flange welds for the control rod drive connection and then we will do a dye penetrant exam of the J-groove welds on the nozzles underneath the vessel.

The pre-service inspections are shown on the next page, the magnetic particle again on the flange to dome weld. We'll do an ultra sonic on that same weld and then we'll do a liquid penetrant exam of the peripheral control rod drive mechanism, nozzle to flange, and that is required by code and we will meet the code on that. Our expectation, our intent is that we will actually get to all of those nozzle to flange welds. We believe we had adequate access --

MEMBER WALLIS: So now we have some theory about the rate of crack growth, you have some idea about how big a crack you need to detect, then you CRDM nozzle and its environment, in order to predict what will happen, say in the next 10 years?

MR. McLAUGHLIN: The next slide, I think we'll describe what we're going to do.

MEMBER WALLIS: I just want to be sure that what you're doing here is going to detect what you need to detect in order to predict what's going to happen, let's say during 20 years or whatever. I didn't ask you that yesterday, but it occurred to me you can match -- that the kind of techniques you're using here on the precision to what you need to know. I didn't ask that, but I'd like to some assurance that you've done that.

MR. McLAUGHLIN: Okay.

MR. SCHRAUDER: The non-destructive exams, the additional exams that we'll do, many of these are to get that base line and to fully understand what -- if there are any existing flaws or cracks.

MEMBER WALLIS: Well, you can't detect below a certain size.

MR. McLAUGHLIN: What we're doing is we're going to do the eddie current of the inside diameter of the nozzles, so that we can detect any surface flaws so that would be a crack initiation spot and then we're also going to do the ultra sonic examination to make sure there are no cracks present.

MEMBER WALLIS: No cracks.

MEMBER POWERS: To make sure we understand any indications.

MEMBER WALLIS: Well, you never detect nothing. You detect up to above a certain size and I just wondered if that precision is good enough. This isn't my field, so someone else should be asking it.

MEMBER POWERS: This is the same equipment we're going to be using for the in-service inspection. So this will be a baseline of --

MEMBER WALLIS: Yes.

MEMBER POWERS: The condition of the nozzles.

MR. McLAUGHLIN: Our expectation --

MEMBER WALLIS: I guess you didn't give me a quantitative answer though.

MEMBER POWERS: Steve Fyfitch, would you please?

MR. FYFITCH: Steve Fyfitch for Framatone. It's not my field either. I'm not a UT, eddy current specialist. But if memory is correct, the eddy current can see a flaw in the surface that's approximately 2 mils in depth and the UT can see something a little bit larger than that.

MEMBER WALLIS: And within how many years would that be expected to grow to a point where you worry about it?

MR. FYFITCH: If you go by industry

experience, we've had vessels in-service, so we've done eddie current inspections on, that have been in service for 20 years and we haven't seen indications on some of those.

MEMBER WALLIS: I was thinking of using all those wonder DADTs we saw yesterday.

MR. FYFITCH: Well, that's -- you know --

MEMBER WALLIS: Maybe we can ask the DADT father there.

MR. FYFITCH: The cracked growth curves, yes.

Do you have anything to say on that, John?

MR. HICKLING: John Hickling, EPRI. As I pointed out yesterday, the DADT curves have been evaluated or derived to evaluate relatively large flaws in their further growth. The industry experience of stress corrosion cracking is that the initial phases of growth are very small flaws or defects is very, very slow indeed and takes up the large majority of life. So it's difficult to make a quantitative prediction in that area because the DADT curves do not apply to those very slow early stages of growth.

MEMBER WALLIS: So it's a qualitative judgment, really.

Thank you.

MR. SCHRAUDER: Let me -- I probably should have said this earlier. Let me state that our intent with this head is not that it will be a permanent replacement, but rather we intend to put this head in now and we are continuing with the procurement of our new head with the new material and our expectation is that we'll install that head on our vessel around the Year 2010 or 2012 when we replace our steam generator. So this vessel will be, or this head will be in service for 8 to 10 years. And I believe that is not very many thru-wall cracks, certainly have identified themselves within that time period.

MEMBER WALLIS: You might have to face this question if you actually started detecting cracks in this Midland head.

MR. SCHRAUDER: Yes sir.

MEMBER KRESS: Why not keep it permanently?

MR. SCHRAUDER: Say again, sir?

MEMBER KRESS: Why not keep the head permanently?

MR. SCHRAUDER: We think that the new material in the new head would be a better option for us and the inspections and the exposure from the inspections on this would still make it a better choice to replace the head with the new material.

This head, as I said, is within the containment at Midland. And that head will not fit for the equipment hatch at Midland, nor will it fit within the equipment hatch at the Davis-Besse plant, so both of those containment structures will need to be temporarily opened and then restored in order to get the heads in and out.

MEMBER SHACK: Will you be left with an equipment hatch so you could bring the next new head through?

MR. SCHRAUDER: No, we will not. The design and the time required to put a new equipment hatch in it's really quite significant. So we'll evaluate when we put the steam generators in whether we want to add a larger hatch at that time, but we're not doing it for this. We'll restore the containment as we find it now.

MEMBER RANSOM: Is the Midland containment going to be restored?

MR. SCHRAUDER: The Midland containment will not be restored to nuclear design. It will be restored for basically weather protection and that's in accordance with consumers' desires.

We will prepare our head for moving outside of the containment also and we'll take the necessary radiological controls to temporarily store that head at the site. Our intent at this time, if it categorizes this low-level waste, we would like to dispose of it now rather than use permanent storage at the Davis-Besse site.

We are going to transfer our service structure and work platform from our existing head to this head. We are doing the modification on the lower portion of the skirt on the Midland head which will remain and we're putting in the inspection ports there to make it accessible for inspection and any cleaning that might be necessary.

We are re-using as I said earlier, I believe, the control rod drive mechanisms from the Davis-Besse head on this head also. As we did look to the repair and had to cut out a couple of the nozzles on the old head, we had to redesign our control rod locations. We will revert back to the original control rod configuration for this new head.

And we'll do a couple of really serviceability modifications to this to the split nut rings to make them easier to get on and off as we go into outages. We also are putting the upgraded gasket design onto these nozzles as we had the Davis-Besse head.

And that's all I have on the head replacement, unless there are additional questions.

MEMBER LEITCH: When you go back in service will you have modified the so-called mouse holes, if that's the right terminology, to improve --

MR. SCHRAUDER: That's what I was referring to. We don't actually modify the mouse holes. The new inspection ports go up a little bit higher than those, but they will have the larger inspection ports.

MEMBER LEITCH: Okay, so that's what that bullet refers to?

MR. SCHRAUDER: Yes sir.

MEMBER LEITCH: Thank you.

MR. SCHRAUDER: Okay, with that, I'll turn it over to Steve Loehlein who has the lead on our root cause investigation team.

MR. LOEHLEIN: All right, the root cause report has been an issue as of about 7 weeks ago and I understand the ACRS members are familiar with it, so we have a brief slides here in the way of summary. I ask that we move ahead to the conclusions as a means of remembrance here.

The key conclusions that we had out of our root cause investigation were that the degradation to the Davis-Besse reactor head was caused initially by primary water stress corrosion cracking which led to nozzle leaks which were undetected which then allowed boric acid corrosion to occur over an extended period of time.

We also concluded that the existing guides and knowledge was adequate to have prevented this damage from occurring.

We also included in today's presentation the time line, just in case Members have questions.

MEMBER FORD: Just for the record, I want to be sure that we understand that we knew physically what occurred, but we don't know in terms of predictions since the specific mechanisms and thereby we cannot tell whether this is, in fact, just a leader of the fleet or that it really is an isolated occurrence. For instance, we don't know the specific mechanism by which you can get 1-inch per year. You don't know the specific design operational criteria that would give you that in any, not just Davis-Besse, but in any reactor of this particular design.

Do you agree?

MR. LOEHLEIN: I think what the report clearly shows is that there's a lot of evidence that substantiates that the corrosion took at least four years in that area, four to six, that even over that period of time it is still a significant corrosion rate for the cavity size that's there.

We also determined through comparison of testing that's been done historically that under the right conditions, rates like that can be created, but I think what you're saying is a question in which we do not have data for is what does it take to get to that point where that type of rate gets established and in this particular degradation issue here, Davis-Besse, we don't have any new evidence that tells us anything more about that. All we know is what we see there and the evidence we do have available is consistent with what we wrote in the report is that if you have a small crack and things go undetected that can go into a leak which through some slow corrosion mechanisms slowly open up the annulus and once there is the ability for communication of air, oxygen with just the right amount of moisture available to keep local temperatures low, these high corrosion rates then become possible.

MEMBER FORD: Again, for the record, it's our understanding that the MRP is considering the conditions that need to be evaluated and then we'll evaluate those conditions which will give us the prediction capability for this particular degradation mechanism.

MR. LOEHLEIN: I hate to speak for them. I can tell you we're working with them and the work that I've seen is in line with what you're expecting.

MEMBER FORD: I just hate to think that this root cause analysis, this document is the end of this whole process. It is not.

MR. LOEHLEIN: And of course, from our perspective and what we had available to us in terms of evidence at the time, there's only so many conclusions that we can draw in looking back from the 1996 to 1998 time frame. We really don't have evidence to look prior to that and draw conclusions from it. You have to use the existing industry body of knowledge to predict what happened prior to that. So all I can say is we uncovered no evidence of anything new. What we don't have, probably, and many people feel we should have a better understanding of these early stages than we have had up until now.

MEMBER FORD: Okay, but you can't say, for instance, you can't disprove a hypothesis that the cavity grew slowly and then grew maybe at 4 inches a year in its final year.

MR. LOEHLEIN: As a matter of fact, that's a good point. It's the reason why we said as a bounding assumption that if you look at the other industry data, a rate is highest at the end with what we would consider to be a bounding assumption, would have been 4 inches which of course means that we would consider that to be kind of a linear assumption than it was maybe one inch per year in 1998.

MEMBER FORD: Right. The one inch a year, taking the one inch a year as being what's going to happen, in another situation, there could be another event where the hole actually closed faster at some stage.

MR. LOEHLEIN: What we can say is that what happened at nozzle 3 in the physical evidence that we have, it appears as though that cavity grew at newly ideal conditions. The right balance of a leak rate with forecast and availability. In actuality, if you have leak rates lower and probably significantly higher, the corrosion rates, we expect would be lower. One case you don't have enough moisture to get the ideal conditions and in the other, you get enough moisture that you get a dilution effect and you don't have as high a concentration of boric acid.

So the combination of a situation where a cavity region was growing at the top of the head, where the boric acid had accumulated could remain there to be constantly available for concentrating mechanism, all these things that build a case that this was a nearly ideal corrosion --

MEMBER FORD: For making a cavity. Now if you have a big leak, you might make a canyon rather than a cavity, it seems to me. That's the flow going down the head.

MR. LOEHLEIN: There's a lot of things that could be speculated as to what would happen in a higher flow rate. Certainly, higher flow rates would show up more readily on RCS than identified leakage as well, probably other things, maybe containment, humidity and so forth.

I guess lots of variations could be conceptualized.

MEMBER FORD: Could you comment on the nondestructive testing techniques that could be used which would be able to size the amount of this degradation, this particular degradation phenomenon?

MR. LOEHLEIN: Do you mean in terms of how large the cavity --

MEMBER FORD: We're hearing that we will be talking about managing all of these degradation issues in terms of visual inspection as appropriate. But what is the capability of nondestructive testing as used in the plant to size a corrosion?

MR. McLAUGHLIN: I'll talk to that.

MR. LOEHLEIN: Yes, I'm no expert in that area.

MR. McLAUGHLIN: What we found is if you look at the ultra sonic testing results and I believe we presented those to you guys the last time we were here, you could see on both nozzles 2 and 3 a couple of clues that something was going on. One, you could see where a normal plot of ultra sonic data, you can see the top of the head. And the location of both of these cavities, you could not see the top of the head. You could also see a location that was obvious that there was no contact between the outside diameter of the nozzle material and any base material. You could see that on the ultra sonic. Now the ultra sonics will not tell you the depth, so you don't know whether it's two mils or six inches. But we did have a clue that something was going on and that's why in our repair process we chose to repair nozzles 2 and 3 first because we did feel that there was some anomaly.

The other thing I would say that from the inspections that we did on say nozzle 2, I believe that you would pick up the area on top of the head, so if you're doing a visual inspection and you had the cameras that we're using now, that you would see that area of corrosion on top of the head. So from a visual standpoint, I believe you would see it. Definitely from an ultra sonics will pick that up.

MEMBER FORD: But it would be by inference in terms of the sizing capability, looking at the top of the head and the amount of boric acid you see on the head, top of the head, it will be by inference?

MR. McLAUGHLIN: That's correct.

MEMBER FORD: If you've got a problem, it would tell you nothing at all, of any of your inspection, kinds of inspection, nondestructive inspection techniques, any way of sizing the amount of that degradation.

MR. McLAUGHLIN: That's correct. I think that you have to have both. You have to use the ultra sonics as well as the visual, if you want to get the size of any type of corroded area.

MEMBER SHACK: Your through the vessel wall for sonic measurement, was that able to size that the minor degradation that you saw at nozzle 2?

MR. McLAUGHLIN: No, what happens is the J-groove weld comes down and you can't do ultra sonics from underneath the head going up.

MEMBER SHACK: That would almost set a limit. If it was any deeper than say one inch or something then I would see it with the through-wall.

MR. McLAUGHLIN: That's correct. You could pick it up then and we did do some ultra sonic tests.

MEMBER SHACK: So that would sort of set a minimize size of a cavity I could detect with the through-wall ultra sonic if I had a shadow on the through nozzle ultra sonic that I wanted to see how big the cavity was behind it, I could say if I didn't see anything on the through-wall it would be less than one inch or something like that.

MR. McLAUGHLIN: That's correct.

MR. SCHRAUDER: But Mark, I think the other thing, maybe it's not noticed here, is that when you have through-wall leak and all the evidence of that and the UTs that show where the cracks are, in the repair process of grinding those out, you automatically expose the area and as a matter of fact, that's how we knew that there was a small cavity region, also two, pretty early, as I understand it because of that, we machined that out. Or is that not true?

MR. McLAUGHLIN: That's true. I mean when you machine the bottom of the nozzle, you specifically machine up above any cracks that are there so you can get all the cracks out and the corroded area should start either at or just above. I think we saw it started just above the cracks, so you know, I would expect during the repair process you would discover that, but --

MR. SCHRAUDER: One thing is clear. The boric acid deposits that appear on the head by the time even at that stage, where it's only 3/8ths inches deep, there is a significant amount of boric acid that's going to escape and it's going to have some rust colorization with it as well. That's consistent with what EPRI saw in its test of an annular. Once you have corrosion by products, they'll be evident in what's expelled out of the annulus.

I think in our figure we have in the root cause report, the cavity region does extend to the top of the head.

MEMBER FORD: Thank you. Unless there's any other --

MEMBER SIEBER: One quick question. On

your bar chart of unidentified leakage there, if I look at that through about the second quarter of 1998, leakage was pretty low.

MR. SCHRAUDER: Right.

MEMBER SIEBER: Then you developed a pressurized relief valve leak and it looks like you shut down, repaired that, started it up again, but leakage was now up. Have you drawn any conclusion as to what that additional leakage, after 1999, said quarter, was?

MR. SCHRAUDER: Certainly. At this time we believe that some of it was due to the development of the leakage at nozzle 3. But as it is with unidentified leakage rates, since this leakage that was ultimately repaired went on for some months, that masking and then that loss of time frame, the staff -- the site staff wasn't able to determine the source of the changes and of course, they could have been attributed to other possible leak sources and there were attempts to look for them, but they never found them.

MEMBER SIEBER: Okay, thank you.

VICE CHAIRMAN BONACA: Just one comment I have. Although the problem may have developed in the last four years, in looking at the root cause, I think you have to look before. Root cause does that. It goes with the early 1990s because although by 1996 you had all the flanges were not leaking any more, but there was a certain mindset in the people from previous outages that you have leakage from the flanges and you can live with it and I think the mindset, it's important to understand. I understand the code allows for leakage to occur from those flanges to some degree. And the question then has to be also is the code proper or adequate because I mean clearly there is a history, if I look at the root cause, it covers about 12 years, that in which there's a certain mentality there that may not be unique to Davis-Besse.

MR. McLAUGHLIN: What you're saying is is from a management standpoint back in the early 1990s with some of the decisions that we made, we set the standard at Davis-Besse before that.

VICE CHAIRMAN BONACA: Right. And I don't want to speculate. I'm not part of the root cause, but I think it's important to see this ingrained thinking because I think it's associated with an interprotectional code and it could be further than simply Davis-Besse.

MEMBER POWERS: And that's a good point

and this is a picture of the technical aspects of the problem that we're resolving at Davis-Besse, but there are larger issues on how this was allowed to occur in the areas of decision making, ownership, oversight standards is where we're driving to resolve the bigger issues in the organizational performance. They got us here, we'll be working with that under the 350 inspection manual chapter process as part of the plant recovery sets of major activities that will be discussed elsewhere.

MEMBER FORD: I'd like to move on at this stage unless there are any other questions for this particular team.

Thank you very much and we appreciate it.

We'd like to move on to presentations by the MRP, Larry Matthews.

MR. MATTHEWS: I'm Larry Matthews. I work for Southern Nuclear and I'm the chairman of the Alloy 600 Issues Task Group of the Materials Reliability Program.

MEMBER KRESS: Those were cedar shakes on that roof.

MEMBER FORD: That's your house, Tom.

MEMBER KRESS: Yeah, that's my house.

(Laughter.)

MR. MATTHEWS: We had quite extensive presentations yesterday with a lot of data and what I propose to do today is try and quickly go through some of the summary conclusions information.

First thing we did was introduce -- not really introduce, but reorient our thinking on how we categorize plants and rank plants to something called effective degradation years where we don't use a reference of some significant degradation like Oconee 3, but we just measure effective degradation years for each plant, which is the same thing as the effective full power years normalized to 600. And this is just a simple chart that shows the ranking of the units and their inspection results to date as a function of where they were in effective degradation years.

The date of the EDY, if you will, was a year ago. We're going to update these to the exact effective degradation time at the time they did the inspections.

(Slide change.)

MR. MATTHEWS: Then John Hickling got up and gave a significant discussion where the expert panel was on coming up with recommended crack growth rate curve. If you recall, the expert panel had narrowed the data base down to 26 heats of material from lots of material suppliers and product forms with the number of data points for each heat ranging from 1 to I guess to 32 for one heat. The method used was to assume a shape of the curve versus stress intensity factor and then to normalize the magnitude of the crack growth rate for each heat to the best fit to that heat data. That's the numbers in the column here. And then plot those and sort those and plot those and fit that with a log normal distribution.

The recommended crack growth curve we've come up with is one based on the parameter that go through the 75th percentile of the heat data.

(Slide change.)

MR. MATTHEWS: This is the data base, all the 158 data points that we have and the dark curve is the 75th percentile of the heat data. If you go back one, basically each one of these points on this curve could be represented as a curve parallel to the MRP curve or the Scott curve on this curve, plot, and then the black MRP curve would indeed be above 75 percent of all those family of curves.

(Slide change.)

MR. MATTHEWS: The application of this recommended curve is intended for the disposition of PWSCC flaws that are detected in the field in thick-walled Alloy 600 components. We don't disposition. We repair through-wall flaws, so we're talking about flaws that are axial ID flaws that are shallow or flaws that may be detected below the J-groove welds.

This crack growth rate curve would be used to determine the crack growth between time of detection and the next inspection interval to decide if it's okay to run for one more cycle or one more operating internal before that flaw is repaired or inspected again or not. And if it's not, then it would have to be repaired at that point in time.

The last two bullets, John pointed out yesterday, were that there's essentially very little or no data on our data base below, approximately 15 megapascals root meter, but for all practical purposes by the time a crack is detected the K would be above that value. So it doesn't really effect the actual use of the curve.

(Slide change.)

MR. MATTHEWS: Then we had Dr. Pete Riccardella, got up and made his presentation on the probabilistic fracture mechanics analysis that's being performed by his company for the MRP. The point in this is to try and determine the risk of rod ejection as a function of time for the units and for the fleet. A model is being constructed and using that model, if we go to the time that Oconee 3 detected their first large leak, they were at approximately 20.1 effective full power years. That would translate to slightly over 21 effective degradation years.

The prediction at the top line is what is the probability they would have detected their first leak at that point and it's over 90 percent. The thick line at the bottom is what is the probability they would have one large Circ. flaw and that's about 12 percent, if you look at this for the B & W fleet, that's close to how many what the fraction of the plants that have detected large Circ. flaws and then the probability of net section collapse is fairly small still, but net section collapse being equivalent to a rod or nozzle ejection.

This model then was used to help us construct a technical basis for the proposed inspection plan that we had come up with. We analyzed plants at various head temperatures and the model hasn't been fully constructed at this point for CE and Westinghouse design, so all this work was basically done with a Westinghouse -- I mean with the B & W geometry but at different head temperatures.

Then we set the risk categories based on the probability of net section collapse per year and also based on accumulative leakage probability. We used both of those and you'll see in the next slide or two that they pretty much parallel each other.

And then set the inspection intervals based on the effect of various inspections on the probability of net section collapse.

(Slide change.)

MR. MATTHEWS: This is a little bit different way of plotting it, but I think it's instructive. The horizontal axis is simply that each individual plant's current head temperature of left axis is the equivalent effective full power years, not degradation years, but effective full power years, normalized to their current head temperature. And for many plants, their current temperature is the temperature they've had for the life of their plant, but there are a few that made modifications to their internal package that has made a significant difference at some point in the life of the plant. These two points, right here being in particular at early in their life they were operating at a significantly higher temperature accumulated quite a number of effective full power years when you normalize it to their current temperature after their modifications and so they -- even though they're now a cold head plant, they had accumulated a significant amount of degradation, if you will, before they made that modification and this methodology that we have of now trying to capture effective degradation years captures that and doesn't then look at then how slow that plant would progress which would be very slow from between 1080 watts and 1580 watts, would take a significant amount of time.

MEMBER SHACK: They must have been a very hot head plant though?

MR. MATTHEWS: They were -- in fact, they may have been over 600. For a Westinghouse unit later design that was perhaps rather unique. I'm not exactly sure. I think they were well over 590 and then dropped their -- they did a significant modification to their upper internals to get their upper head temperature --

MEMBER SHACK: But I mean Davis-Besse and Oconee run over 600 and they're way down at 18 years.

MR. MATTHEWS: Well, they're down at 18 effective full power years at 600. They're actually 20 something effective degradation years, if you will, whereas this plant is only slightly over 10 effective degradation years. Got it?

MEMBER SHACK: Yes, I keep getting -- between EDY and EFPY.

MR. HISER: Bill, this is Allen Hiser from NRR. That plant was operating initially at 601 and dropped to about 561 after their steam generator replacement and other related mods.

MR. MATTHEWS: From our kind of generic analysis, we pulled off the function of temperature here the effective full power years at that temperature at which the plant would reach net section collapse probability of 1 times 10^{-3} and 1 time 10^{-4} and those are the two chain link curves here and then we also pulled off the probability of leak being 75 percent and 20 percent and those are the dark solid blue line here and the gold colored line here. You'll note they very closely parallel the curves for the net section collapse probability at 10^{-3} and 1 time 10^{-4} and then we also just plot and this is a fairly simple plot to do, the effective degradation years on where a five effective degradation years would be in terms of EPFY, 10, 15 and 18.

In the upper set that we talked about, tends to be very close to the 18 effective degradation years, the 10^{-4} on that section collapses very close to the 10 effective degradation years. And so for the purposes of our inspection plan, the initial inspection plant. We had proposed that everything above 18 effective degradation years be classified in the high susceptibility or high risk category, between 10 and 18 be moderate, and below 10 be classified as low, and then come up with a graded inspection approach as a function of which category the plant was in as a function of time.

(Slide change.)

MR. MATTHEWS: We also looked at the impact of the inspections that could be done but bare metal visual and NDE. For the bare metal visual we assumed a fairly low probability of detection in today's world of .6 and then we also -- if a flaw is missed, in other words, if there is a leaking penetration that's not detected by the bare metal visual and it's in that .4 that's missed the first time you do the inspection after that leak develops, the next time that one is inspected, we knock it down, for that nozzle, down to .2, so -- I mean .2 times .6, so there's only about a 12 percent probability that that would be detected in subsequent cycles. So that's the kind of credit we're taking for the visual inspections and then for nondestructive examinations under the head, there was a POD curve from an EPRI report based on size that was used and then we knocked that down by 80 percent.

(Slide change.)

MR. MATTHEWS: If you look at the effect of the inspections, the blue line is the probability of net section collapse. These calculations, I believe, were run at 600, so EPFY would be the same as EDY. The probability of net section collapse with no inspection would be the blue line. And the effect of doing a bare metal visual, the recommendation for a moderate plant which is 1 over 10 EDY, doing that every 2 EDY would that knock down on the probability of -- and you only have a 12 percent probability of picking it up later. It initially has the significant impact on the probability of net section collapse, but then that tends to go back up over time because of the low probability of detection over time.

Recall that at this point while we're still below 3 times 10^{-4} on the probability here, we would move that plant into at 18 EDY, we'd move it into the high susceptibility category and impose a different frequency on these inspections.

The effect of NDE with the PODs that we had assumed in these models is significantly more and because of that better inspection capability keeps that probability of net section collapse down all the way out until the plant moves into -- and even though it's on a lower frequency, it keeps it down as you move on down, out.

(Slide change.)

MR. MATTHEWS: After that --

MEMBER WALLIS: Before you go on to this,c an we go back to your Figure 6?

MR. MATTHEWS: Yes.

MEMBER WALLIS: Because we've had some time to think about it.

MR. MATTHEWS: This one?

MEMBER WALLIS: Figure 6, next one.

MR. MATTHEWS: Yes.

MEMBER WALLIS: I'm trying to think about what it means. The Scott curve is a curve fit to some data for a steam generator experience and it has three constants in it, alpha, beta and 9; 9 has been chosen not to change. Data is 1.16. You assume it's the same as the steam generator experience.

MR. MATTHEWS: Right.

MEMBER WALLIS: So the only coefficient in this equation that's been tweaked is alpha.

MR. MATTHEWS: Correct.

MEMBER WALLIS: And alpha is tweaked by means of a method which you use for Figure 6. There's a cumulative distribution function. Essentially what's happened it's a way of getting a mean alpha for all the heat, right?

MR. MATTHEWS: Correct.

MEMBER WALLIS: So once that has been done, you've determined your Scott equation and all you've done is found an alpha. What's the best alpha to describe this huge amount of data.

MR. MATTHEWS: Exactly.

MEMBER WALLIS: On average, right?

MR. MATTHEWS: Exactly.

MEMBER WALLIS: And then Figure 6 then, nothing has been derived from Figure 6. Figure 6, you're simply saying given that you've made this decision to choose this alpha, which is the only parameter you've derived from the data, the only parameter, very gross thing, here's the curve and here's the data and it's not a surprise it goes to the data because it was derived from mean alpha for the data.

And so looking at it, what are we supposed to conclude? I guess we conclude that there's an enormous amount of scatter. That's about all we can conclude from this figure. It's not a derivation of anything. It's just a comparison between a curve and data which is all over the map. That's all we can conclude from this figure, right?

So I'm just wondering what I ought to conclude, since I think I now understand what you've done.

MR. MATTHEWS: Okay. Well, what we're proposing to do is use this as an estimate of the crack growth rate to be used if we have a flaw that is detected in the field.

MEMBER WALLIS: Right.

MR. MATTHEWS: To determine the crack growth rate to assess whether or not that flaw could be left in service for some period of time.

MEMBER WALLIS: I guess I'm sort of familiar with science and engineering and I just wonder seeing this whether this gives me a good feeling, that we've got something reliable as a predictive tool.

If I saw this -- I would be very suspicious of this in any other context.

MEMBER SHACK: If you believe this was a fit to the data, you'd wonder why in the world they were fitting --

MEMBER WALLIS: They're not fitting this.

MEMBER SHACK: But they're not fitting it to the data and -- but you somehow look at it as though it is a fit.

MEMBER WALLIS: No, I look at it as a -- given that you've chosen this alpha to reach your conclusions and you've chosen to fix beta and 9, this is somehow telling me, well, I've made that assumption. How well does it compare with all the data I've got. This is what this is telling me.

Do I feel good about that? I don't know why I should feel good about that.

MEMBER SHACK: If you made each of those dots a different color to represent his 21 heats and then he plotted 21 curves, you would see that the curve is a reasonable representation of the data for a particular heat.

MEMBER WALLIS: You mean if you have different curves for each heat.

MEMBER SHACK: Yes.

MR. MATTHEWS: Yes, like I said if I take each point on this, that represents one heat.

MEMBER WALLIS: We haven't seen that. We haven't seen how well one of these alphas fits with a data where you've got say 26 points instead of 1.

MR. MATTHEWS: Right.

MEMBER WALLIS: And we haven't seen that.

MR. MATTHEWS: Each one of these would be a separate curve.

MEMBER WALLIS: You've got to sort of make a judgment about whether your method is appropriate as a reliable predictive tool.

MEMBER SHACK: No, clearly you can't have a predictive tool with a single curve with this much variability in the crack growth rate data.

MEMBER WALLIS: Right.

MEMBER SHACK: It's a hopeless task. It's an unreasonable thing to expect. Until you can come up with a predictive tool to tell me what alpha is for a given heat, but he has to make some -- you can argue whether his choice of a 75th percentile is appropriate as a way to --

MEMBER WALLIS: Well, I guess in a sense you've got a great deal of insecurity here. You've got to be very conservative is what I would conclude.

MR. MATTHEWS: Pete.

MR. RICCARDELLA: I'd just like to point out what you're focusing on now is really --

MR. MATTHEWS: Just state your name, please.

MR. RICCARDELLA: Pete Riccardella from Structural Integrity Associates -- is really at the heart of the probabilistic fracture mechanics analysis because this huge scatter that you're seeing on this chart really dominates the results and the probabilities of getting a large crack.

You'll notice the horizontal line here at 1 millimeter per year and then if I go up an order of magnitude to where those higher data points are, that's 10 or actually more like 15 millimeters per year and in our Monte Carlo sampling in this probabilistic fracture mechanics, one out of every thousand points that we pick is way up there, that's over half an inch per year and of course those are the ones that lead to ultimately to the net section collapse if it's grown at that speed.

MEMBER WALLIS: So one could wonder if your tail is right -- I've got 6 points up there at the high end.

MR. RICCARDELLA: Yes.

MEMBER WALLIS: And I sort of wonder if cutting off the tail in the statistical way --

MR. RICCARDELLA: Well, but where I cut it off -- I've presented yesterday results where I did a log triangular and then also a log normal and show that that was about a factor of 2 difference on the probability of failures.

The log normal didn't cut off the tail.

MEMBER WALLIS: I think you did a splendid job with what was available.

(Laughter.)

MR. MATTHEWS: And that is what's available.

MEMBER WALLIS: But we've got to face up to the fact that there's a lot of insecurity about this and I agree, you have to do statistics, but then how you treat that tail up at the top there makes quite a difference.

MR. RICCARDELLA: Well, that's why I presented results from treating the tail in two different ways.

MEMBER WALLIS: I know.

MR. RICCARDELLA: To show what the effect was.

MR. MATTHEWS: The tail is a couple of the worst performing heats.

MEMBER WALLIS: It's actually about six of the worst performing heats.

MR. MATTHEWS: Above the 75th percentile, yes. It would be.

MEMBER RANSOM: Well, is the heat, for example, a random parameter? It seems to be a more important variable than any of the rest?

MR. MATTHEWS: It is.

MEMBER RANSOM: Why are you focusing on that then?

MR. MATTHEWS: We don't know which heats a priori are going to be the ones that going to --

MEMBER RANSOM: If I were the general public I would say maybe you better take the worst heat.

MR. MATTHEWS: That's one approach that we could do. But the approach that we've proposed is to take a -- what we consider a fairly conservative estimate of what the crack growth rate might be for there. Certainly, it's not the ultimately bounding every data point that's ever been generated crack growth rate and then use that to make a best estimate of how far the crack would grow in the next interval and then tack margin on so that even if you're off some, you've set a limit. So even if you miss it, you're still not into any kind of catastrophe and even if we did miss it, and the crack did go through-wall, we're still well away from a net section collapse because you've still got time for that crack to then turn and grown circumferentially.

MEMBER RANSOM: Maybe I'm missing something, but do you drive on uncertainty to go along with this best estimate?

MR. MATTHEWS: No, no.

MEMBER RANSOM: But if you're going to use probabilistic methods it would seem like that would be the appropriate thing to do.

MR. MATTHEWS: In this right here, in the probabilistic methods, we didn't use a curve with an uncertainty. What we used -- well, I guess it might translate into that, but we used the whole scatter of the data base was put into the -- and sampled in the Monte Carlo analysis.

MEMBER KRESS: How long do you scatter above the 75 percent --

MR. MATTHEWS: Actually, the whole data base was used in the Monte Carlo. And like we said yesterday, we don't have any zero points in here. They weren't included --

MEMBER WALLIS: You see, your whole hypothesis is stress intensity factors and the main variable affecting crack growth rate and that isn't shown at all from this figure.

MEMBER SHACK: For a given heat.

MR. MATTHEWS: For a given heat it is. And if I had plotted these so that you could tell these two and whatever the other points are for one heat and these down here are from another heat, you could say that well, okay, this shape is probably pretty good for a given heat. The heat gives us a sensitive parameter, but we don't know those parameters necessarily that's driving that for every heat out in the field.

MEMBER WALLIS: Well, we're not going to resolve this today.

MR. MATTHEWS: No, we're not.

MEMBER FORD: Hold on, there might be a -- John Hickling.

MR. HICKLING: John Hickling, EPRI. May I just remind you of two things I presented yesterday. I did, in fact, show two curves of the individual heats and at least in one of them you could see as Bill Shack says, the 50 is quite reasonable on a heat to heat basis, but let me remind you that all of the lab data does tend to be biased towards higher stress corrosion crack growth rates because a deliberate choice was made when many of the experiments were done to choose a heat which was known to be susceptible to cracking. And that's a bias which is in the laboratory data inevitably because the experimenter was desirous of obtaining a result in his test. And I fully -- I understand the problem that one has visually with this picture. I have it myself. There is that hidden bias in there which shouldn't be forgotten.

MEMBER FORD: Could I ask that we move on?

MEMBER SHACK: Since we're all talking about our warm and fuzzy feelings, my warm -- the problem where I don't have the warm and fuzzy feeling is in the K solutions yet. Until Pete explains to me why the zero degree nozzle one doesn't act like the way I expect it to act, that's really step one in this whole process. If I'm not warm and fuzzy up there, then I have a time following the chain down.

MEMBER SHACK: K is not the driver.

(Slide change.)

MR. MATTHEWS: Let's see, where was I? Then I was going to move into Glenn White from Dominion had gave a presentation on the work that Dominion Engineering is doing for the MRP relative to the progression or the possible scenarios for progression from a leak to a cavity and his work was trying to answer a couple of questions if there is a significant amount of head loss, would it be detectable visually? And I think his conclusion there is yes, the products that are going to be generated in that corrosion are going to be available on top of the head for detection and then is there a period of time following the initiation through-wall leak for which there is assurance that if we don't have unacceptable reactor vessel head corrosion and we believe, but we haven't finished the work yet, that there will be a significant period of time between the initiation of any corrosion and the time the cavity gets to be significant and the growth rate becomes significant.

(Slide change.)

MR. MATTHEWS: He looked at all the possible mechanisms and he characterized them as a function of the flow rate from 10^{-6} up to 1.0 gpm. He looked at the thermal-hydraulic environment, the chemical environment, properties of boric acid and their compounds and the relevant experimental results that are available.

His conclusion at that point was that the leak rate is expected to be the key parameter, primarily I think based on a couple of things. The expansion cooling at the leak rate increases, potentially could get to the point where a liquid film would be available and then it would be very easy to get some very high concentrations of boric acid at essentially saturation temperature and atmospheric pressure which are known to be highly corrosive. And then the increasing leak rates from higher velocities could get into erosion or flow accelerated corrosion mechanisms.

MEMBER FORD: Could you go back to that last slide? I want to be sure that we all realize that there's very, very little data to support this hypothesis as to the specific mechanism of degradation. That is reasonable. The hypothesis that the leak rate is a critical parameter is reasonable at this stage.

If subsequent experiments, which I hope there are subsequent experiments to prove this hypothesis, then it's going to be fairly obvious that current technical specification of one gallon per minute may have to be modified. Do you agree?

MR. MATTHEWS: I guess I'm not going to try to answer that right now. I don't know. One gallon per minute clearly -- I mean clearly Davis-Besse got into a situation where they eroded a cavity or corroded a cavity on their head with less than one gallon per minute leak.

If the purpose of the one gallon per

minute tech spec is to try and prevent something like that, it doesn't do it. If that is not the purpose of the one gallon per minute tech spec, then maybe it doesn't and I'm not a tech spec guy. I'm not sure what the purpose of that 1.0 gpm was to start with.

MEMBER WALLIS: Okay.

MR. MATTHEWS: But if you're going to try and protect bio tech spec on unidentified leak rate, 1.0 gpm will not -- I mean it clearly did not stop what was going on at the Davis-Besse plant.

MEMBER WALLIS: Thank you.

(Slide change.)

MR. MATTHEWS: The leak rate also determines how much boric acid gets out of the system on to the top of the head or wherever else it goes and Glenn tried to use -- or I don't know that we've actually gotten to the point of trying to define a time line. I think he has looked at how much low alloy steel material might be lost versus the volume of boric acid and/or corrosion products that would be available for detection. He did not present anything on that. This was the basic result that he had going from a through-wall leak to the annulus that was not leaking to the top of the head because of being sealed off above the leak for some reason, having zero leakage up to .01, I mean .001 gpm, .01 and then the various increasing flow rates on up to greater than .1 gpm.

The types of flow, I mean the types of possible significant corrosion mechanisms or degradation mechanisms that would be taking place in each of those flow regimes and this seems to present a plausible progression from the through-wall crack in the nozzle or weld progressing to a larger flaw with a larger flow rate in the degradation progression as we go.

Almost all the other nozzles that have been detected with leaks in the U.S. industry, well, in the world, have been in this range here where there's been very, very little flow rate and very little boric acid accumulation on top of the head.

I guess we think that Davis-Besse had progressed further in that process and we're over into this range of degradation creating a larger cavity.

Glenn's not through with his work. It's labeled preliminary. When he gets through with that, we will find, I think we'll be putting more of a time line on this as best we can, but like we say, there's not a lot of work at these kinds of flow rates at this point and trying to do that we may wind up trying to spec tests that need to be done at these flow rates.

MEMBER WALLIS: This is very interesting preliminary work and I agree it presents plausible progression and we had some questions about some of the details yesterday which I don't want to get into.

I just wanted to ask that although this is preliminary, you are somehow using it in the guidance which we're going to get next and when to inspect. I mean what do you expect to happen physically and it's going to influence your strategy of inspection, it seems to me. Is this very preliminary work, being fed into the inspection strategy or not at all?

MR. MATTHEWS: I think it will be. Basically, if you recall from the presentation yesterday on the inspection plan, that initial proposed inspection plan did not take into account the wastage issue in any shape other than to assume that there would be some improvements in the boric acid control program that would prevent that issue from happening.

The staff gave us the comment. We need to marry these two issues and so we've taken that comment back and we're going to try and very rapidly come back with a modification --

MEMBER WALLIS: So you don't have an

answer to my question yet.

MR. MATTHEWS: Well, the answer to your question is no, this was not taken into account because that program that we initially proposed --

MEMBER WALLIS: But you're thinking of taking it into account?

MR. MATTHEWS: Yes. This would have to be taken into account in response to the staff's request that we marry any inspection programs --

MEMBER WALLIS: Realizing that again this is not a very secure science.

MR. MATTHEWS: Right, it's plausible, but is it absolute, no, not yet.

MEMBER FORD: I'd point out for the record that corrosion science is one of the oldest sciences, in my own defense.

MR. MATTHEWS: Okay.

MEMBER FORD: I mean they all do. Science gets them all confused.

MR. MATTHEWS: Then we presented a presentation, Michael Lashley made this presentation on the proposed inspection plan that we had discussed with the staff on May 22nd and like we said that initial proposed inspection plan did not take into account on how to protect against the wastage issue.

It was a nozzle ejection issue that that plan was trying to protect against.

We received significant comments from the staff that we should marry the plan with the wastage protection inspection plan and look at, like you say, the time frame for the wastage development, whether or not the tight nozzles will indeed leak because one of the basic tenets of the plan was that they would and that visual would be an adequate way to detect initial leakage in the plant.

And then the policy issue is that an acceptable way to detect when a plant initially has the problem by an initial leak and then we also did not address replacement heads because we recognize they would be of a different material, but they said the plan needs to at least put out some kind of inspection recommendations for the replacement head.

I've left out all the detail slides here, but just went straight to the flow chart.

(Slide change.)

MR. MATTHEWS: Like I showed earlier, categorized plants, that's low susceptibility, moderate susceptibility and high susceptibility based on their effective degradation years. A low susceptibility plant, we had recommended that they do

100 percent bare metal visual or alternatively if they chose or wanted to, 100 percent NDE. Do that once every 10 years after the plant has been operating for 20 years, some time in their third interval.

For a moderate susceptibility plant, we had recommended 100 percent bare metal visual. The first outage that they entered this category and then once every two effective degradation years after they get into that category. Put a cap on that of 5 effective full power years because some of the low temperature plants two effective degradation years could be a significant amount of time. If it's a high temperature plant, two effective degradation years is effectively going to be every refueling outage.

Alternatively, they could also perform the nonvisual NDE, the first outage, and then at half the frequency of the visual because the nonvisual NDE would detect cracks at a much earlier stage than the visual would.

The high susceptibility category, initially we were thinking about just doing bare metal visual, but could cover what we don't know. It was recommended that we include 100 percent NDE for those plants that are in the high susceptibility category and there was a time, a grace period because -- four years after NDE category or issuance of this plan and that was because there's a limited amount of tools out there and when the plan hits the street, there may not be enough tools to do all the plants that might be in that category the first time it's out there.

But like I say, it's to cover what we don't know and we're requiring them to do that.

The bare metal visual would have to be performed every refueling outage or alternatively the nonvisual the first time in every four effective degradation years. And the four effective degradation years were based on how long the cracks would take to grow through-wall, etcetera.

MEMBER FORD: Again, just for the record, I think that's a very dangerous argument to make.

MR. MATTHEWS: Which one?

MEMBER FORD: Just because you don't have the tools, you're not going to inspect.

MR. MATTHEWS: The basic plan is based upon the visual and the NDE requirement that we're placing on the plants when they enter the high category is there, like I guess in the terms of my executive vice president, that's to cover what we don't know. We base the plan on what we think we know and that the visual was adequate to cover that. The nonvisual was there to cover what we don't know.

MEMBER FORD: I'm assuming that since this is on-going discussions with the staff --

MR. MATTHEWS: They're likely to have a different perspective.

(Laughter.)

MEMBER WALLIS: Could I ask, it is based on what you think you know and the arguments for what you think you know are overly -- have been quite good. But we've heard good arguments before Davis-Besse too.

MR. MATTHEWS: Yes.

MEMBER WALLIS: So once per 10 years seems as if you're really very, very confident that nothing surprising is going to happen in those 10 years.

MR. MATTHEWS: Like I said, this initial plan was based on just protecting against the next section collapse from PWSEC. As we go back and try to marry this inspection plan with something that's going to protect against the possibility of a wastage cavity. I suspect that several of these frequencies will have to be changed and possibly even the inspection techniques.

MEMBER FORD: Okay.

MR. MATTHEWS: Once you do the inspections what we had the plants do, if they detected a through-wall leak, the plant is reclassified as a high susceptibility plant and the only way to get out of that category then is to replace the head.

I guess theoretically you could replace al the nozzles and welds, but that would be prohibitive. We require them to -- they would be required to characterize the indication that they have that's generated the through-wall leak or through-wall crack or the leak. We can't run with that, so to prevent leaks in the future we'd have to pare that nozzle and then perform 100 percent NDE on the rest of the nozzles.

This was at the next refueling outage and I know this is one of the things we received comments on as allowing another cycle there. We'll have to look at that.

Basically, the logic behind that was you had performed some inspection that assured you that you had detected all of the leaks and you repaired all of the leaks. Agreed, there is some small probability that another leak might develop in the next cycle, but you're not sitting there with another nozzle that's been leaking for a number of years and growing a Circ. flaw because that would presumably have been detected in the other inspections. So that was the initial logic between doing that. The plant would then be reclassified and go back into the high susceptibility category.

If a low susceptibility plant detects any cracking, we're going to stick that plant into immediately into a moderate susceptibility cracking plant, unless it's through-wall and then they go to high. And then based on that crack and everything, they would have to determine their new inspection interval and what category they would be in.

But that's basically the initial plan. I can say we've received comments from the staff when we initially presented this. We're on a fast track to try and incorporate those comments and decide how we're going to modify our plan to address the issues that the staff raised and get back with them on another proposal.

MEMBER SHACK: Your temperature counts for one of the big variables that you're going to have in your susceptibility. The other one is the heat, the heat variation which we have no good way of handling. Have you looked to see with your current scheme what fraction of the heats you would be looking at in the high susceptibility category, that is, would you have captured a fair sample of the heats to assure yourself that you didn't have a moderate susceptibility plant based on temperature with a high susceptibility based on heat?

MR. MATTHEWS: We haven't done that, but I think we have the information that we could do that, that look. And that's something I think we ought to go back and take a look at.

MEMBER SHACK: It seems to me that somehow you ought to set this up so that your high susceptibility thing where you're going to be doing the nonvisual captures at least enough of the heats to give you a confidence that you've looked at those, even though they might be moderate susceptibility in terms of temperature.

MR. MATTHEWS: Pete, you want to say something?

MR. RICCARDELLA: Yes, I just wanted to -- this is Pete Riccardella from Structural Integrity. Remember that a big part of the categorization is based on the high susceptibility heats. Remember our time to leakage correlation which is that Weibull fit is strictly the B & W plants. So pretty much that part of the assessment is based on the higher susceptibility heats. And --

MEMBER SHACK: You did a triangular

distribution, but your triangular distribution was only --

MR. RICCARDELLA: Only of the seven B & W plants which tended to be -- we believe, tends to be the higher susceptibility heats and don't forget we also correlated the crack growth to those as well.

MEMBER SHACK: You might get a certain amount of debate on that in terms of the heat basis.

MEMBER WALLIS: Yeah, I think so. They're high temperature plants. We don't know really know that they're the high susceptibility heats. There could be some other -- heat is such a mysterious thing that there could be other bad heats out there and I would really like to have a physical basis for making the difference, not some mysterious heat that no one knows what it is.

MEMBER FORD: I'd like to draw a close to this particular message. Any other questions.

MEMBER RANSOM: I'd like to make an observation or a comment that this may not apply to future things, but just the Davis-Besse observation of one of simply taking the massive material removed from the head and did a chemical analysis, you would have realized that the iron content, the amount of iron you're removing was significant.

And I'm wondering if a mass balance on the iron, I know that in a nuclear plant on any radioactive material there's a very detailed mass balance made. But even if you just took the material off the head at an inspection and analyzed it, you would realize whether you're removing grams, kilograms or what mass of iron is being removed and in fact, it might be worthwhile if the material has been preserved from the Davis-Besse head to estimate how much iron is actually in that.

MR. MATTHEWS: I'm not aware of how many barrels do you have locked up somewhere. None?

MEMBER SIEBER: Well, a lot of it stayed on the head, but some dripped down the sides. Some of it went into fan coolers, some of it is all over the containment.

MEMBER RANSOM: Sure, so that would only tell you that if you are removing significant iron in that, that I actually remove more than that.

MEMBER SIEBER: That would tell you --

MR. MATTHEWS: Probably not totally uniform in its constituency either.

MEMBER SIEBER: Right.

MR. MATTHEWS: Coming out in this amount versus that --

MEMBER RANSOM: Well, you've got to sample it, of course, than do a statistical.

MEMBER FORD: I'd like to bring this particular discussion to an end. Thank you very much, Larry.

MR. MATTHEWS: You're quite welcome.

MEMBER FORD: We'd like to call on the staff, Bill Bateman.

We'd like to ask Bill Bateman and his staff to make their presentations.

MR. BATEMAN: Good morning. I'm Bill Bateman, NRR, Chief of the Materials and Chemical Engineering Branch and with me at the table are Ed Hackett who is representing the Lessons Learned Task Force and Jack Grobe from Region III as a Division Director of Reactor Safety and also leading the 0350 Panel.

(Slide change.)

MR. BATEMAN: I've got one slide here and I'm going to try and go over quickly what the staff discussed yesterday. The first item is to update you on where we're at with respect to the status of the bulletins from the last time we briefed the full committee. I'll start with Bulletin 2001-01. As you may recollect, Bulletin 2001-01 was issued to address the concern with circumferential cracking and vessel head penetrations.

We emphasize with the bulletin that the high susceptibility plants had to inspect within a certain time frame and that was accomplished and we did identify, the plants did identify some cracking in VHP nozzles and those were repaired.

This most recent outage season, there were no other additional cracks identified as a result of inspections that were performed. So that gives us at this point some confidence in the susceptibility model. I know we've had discussions here about heats and their potential impact and I think there's definitely something we're going to look into, but at least at this point in time we haven't found anything as a result of the inspection data that would concern us that we are totally misled by the time and temperature susceptibility model. So that's kind of the status of where we're at with Bulletin 2001-01 at this point.

MEMBER LEITCH: I have a question that relates to BWRs. With respect to the CRDM cracking issue, the boron in the PWRs was an important indicator that we had some incipient through-wall cracks and the BWRs we don't have that obviously. And in the stub tube barriers, we have some of the same. I mean it's difficult to inspect which might be analogous to the head of the PWRs. It's -- there's some tolerance perhaps for, in some plants, for a little bit of leakage down there. There are so many things that can possibly leak. It's not uncommon to have a few drips coming out of there which may be, in my mind analogous to the tolerance in the PWRs and the flange leaks and that's kind of clouding the picture.

Admittedly, you have a much lower temperature down there in the BWRs, but I guess my question is have you thought at all about whether there's applicability of this issue to the BWR stub tubes and other, CRBs and other instrumentation penetrations that are down there in the belly of the BWRs?

MR. BATEMAN: Yes. We have. As a matter of fact, there are at least two plants that come to mind that have had leaks in their stub-tube welds and we have allowed them to roll repair those stub tubes to stop the leak.

But the one thing that we do take some confidence in is the weld bead and how the stub tube is connected to the housing such that even if the weld were a through-wall crack you still have that weld bead around the OD of the stub tube that would prevent nozzle ejection.

MEMBER LEITCH: I guess I'm just not familiar enough with that design to quick picture what you're saying. Could you say that again?

MR. BATEMAN: You have the stub tube which comes through which you install the housing and then you basically weld the housing to the stub tubes. So if you picture a Philip weld in your mind, that Philip weld is attached to the housing and to the stub tube. If that crack, if that weld were to crack, you still have the Philip weld which acts as a blocker for that housing to go, move through the stub tube and out of the bottom of the vessel, where you don't have that situation here in the PWR design.

MEMBER LEITCH: So you could get a significant leak, but not a --

MR. BATEMAN: But not an ejection, right.

MEMBER LEITCH: Okay. And the temperature is --

MR. BATEMAN: Substantially lower, so you wouldn't expect there to be nearly the susceptibility.

We have seen some leaks at the older plants, Nine Mile and Oyster Creek have got some leaks. As I said and we have performed some role repairs as a temporary repair, but we're pushing for more permanent repairs. There is a recent code case that's provided an avenue for them to make a more permanent repair.

MEMBER ROSEN: What's the temperature at the stub tube, typically?

It seems lower.

MR. BATEMAN: Right off the top of my head -- what's the saturation temperature for --

MEMBER LEITCH: 545, I think.

MEMBER ROSEN: So it's in the range of the cold head plants, PWR cold head, even below that.

MR. BATEMAN: I'm not exactly sure either what the weld material is. I think it's -- and maybe some of my staff might know. I think it's a stainless steel weld as opposed to an alloy 600 weld.

MEMBER ROSEN: But a few degrees temperature difference is very significant. I mean this phenomenon is highly temperature dependent and what you would expect in the normal engineering disciplines to not matter, a few degrees Fahrenheit, it turns out to matter quite a bit.

MEMBER SHACK: Well, I'm not sure that's true in this case. You know the mechanism in the BWR is not PWSCC and I don't -- I was actually trying to think last night when Graham mentioned this to me, what we know about temperature dependence, but by and large the temperature dependence of the mechanism is likely to be operative in the BWR, I don't think will be as temperature sensitive as PWSCC is, although I don't think we have a whole lot of data on that although Peter would know that.

MEMBER FORD: I don't know if I can say anything because of a conflict of interest but I'm sure Dr. Hickling could address that issue.

MR. HICKLING: Just a brief, comment, John Hickling, EPRI. Bill Shack is, of course, completely right. It's a different mechanism in the BWR and the weld metals susceptibility, whether it be 182 or to a lesser extent 82, is well known, has been for many years. But it's not comparable, certainly not in terms of temperature dependance to the PWR situation.

MEMBER ROSEN: I got too far along there. Really, all I was trying to find is what is the temperature and I think the answer was 545 or something like that.

MEMBER WALLIS: In terms of a Scott curve you're probably below the magic number 9. It's not 9 in this material. But it's something.

MEMBER SHACK: No, no, no. Because your activation energy is likely to be quite different and it's cold comfort farm. It might be cold --

MEMBER WALLIS: That doesn't help you?

MEMBER SHACK: That ain't buying nearly as much as it does in the PWR case, at least I believe that would be -- there's much sparser data.

MEMBER FORD: But if I could make a comment in relation to your concern which really comes down to is anything being done about assessing that particular phenomenon and yes, there's a tremendous amount of work being done, background work in the laboratory on cracking of 182, 82 and 600 in BWR environments.

It's not as though we're just sitting on our thumbs and doing nothing.

MR. HICKLING: John Hickling, EPRI. I had one comment. Of course, in the BWR, you have an effective mitigation technique by the use of hydro and water chemistry and one of the main driving forces behind hydro and water chemistry is to protect that sort of material down at the bottom of the head.

MEMBER LEITCH: Yeah, it's just there is a lot of history before some of these plants went to hydrogen water chemistry and some of that with relatively poor control of reactor water chemistry in the early years.

MR. BATEMAN: Okay, I'll move on to the status of Bulletin 2002-01 which was the bulletin we issued right after Davis-Besse head degradation was identified and that bulletin was issued to give the staff assurance that there were no other Davis-Besse's out there. And basically issued that bulletin requesting licensees to respond within 15 days and they did and we basically have reviewed all the responses and at least at this point in time have confidence that we don't have any other Davis-Besses out there.

We had some discussion yesterday, as you recall, about how do we gain that confidence and was basically based on the licensees' responses and subsequent phone calls by my staff to follow up on questions that arose from our review of their responses. It was not based on individual NRC observation of each reactor vessel head.

So anyway, that's where we're at with Bulletin 2002-01. When we did get the 60-day responses which asked for information on their boric acid inspection program. Those came in, I guess, last week and we're in the process of reviewing those. I think we got through about 20 percent of those. So that's where we stand on Bulletin 2002-01. Any questions on that?

Okay, the next item is we spent quite a bit of time yesterday listening to data analysis of crack growth rates and all that sort of thing and I think where it's all leading to is where do we go from now? I don't think any one of us wants another Davis-Besse head degradation type scenario. I don't think any of us wants any more circumferential cracking to the extent that we found at Oconee. So that's where our challenges are. What's the next step to go on from here?

And I think it's the inspection plan. I think that's where we're at. We've got to agree between the industry and ourselves what will be an effective inspection claim so that we don't have -- we won't have this kind of situation again and that's what we're working on right now. You heard the industry's presentation. We're basically at this stage working on a piece of generic correspondence to bridge the gap between now and the time we come to agreement with industry and then in some way codified either in the ASME code or through rulemaking and the regulations.

We haven't decided exactly what our position is on that yet, but I can assure you that it will be in excess of what industry has proposed. Until we -- and then we'll back down from that over time, given that industry presents a technically sound argument to justify that.

MEMBER LEITCH: What's the time frame for this interim communication? Do you have a time in mind for that?

MR. BATEMAN: It's in draft right now and it's going to be moving pretty quickly, so I would say barring any unforeseen difficulties, I would say within the next month and a half.

MEMBER LEITCH: Before long, the fall outage seasons is going to be upon us.

MR. BATEMAN: Yes.

MEMBER LEITCH: And I'm sure that a lot of plants, if that impacts their inspection program in the fall, as I suspect it might, they need that information in a timely fashion.

MR. BATEMAN: Agreed. And we've had various licensees express that to us.

MEMBER SIEBER: Actually, if you wanted to hire technicians and rent inspection equipment, they ought to know now.

MR. BATEMAN: I think a smart licensee would --

MEMBER SIEBER: Do it any way.

MR. BATEMAN: Do it any way. I mean if you're going to wait around for the regulator to tell you what to do, you may be caught between a rock and a half place when it comes to outage time.

MEMBER ROSEN: How are you going to impose the requirements of this new plant? What regulatory vehicle will you use?

MR. BATEMAN: What we're contemplating right now is a bulletin and a bulletin basically is not -- doesn't require licensees to do anything. We only have limited vehicles that require licensees to do anything, for example, orders. We're not contemplating orders at this time, but I think it will be based similar to the Bulletin 2001-01 where we'll ask the licensees what their plans are and we'll represent what we consider to be an acceptable answer to that question.

It would be undoubtedly based somewhere along -- something similar to what the licensees have presented for an inspection plan, but more than likely will have different intervals and frequency, different methods and frequencies.

Any other question son that? If not, I'd like to turn it over to Jack Grobe, to give you a brief update on the 0350 Panel.

MR. GROBE: Thanks, Bill. I apologize. I wasn't able to reduce it to one slide, but I do have a couple of slides, just summarizing what we talked about yesterday.

Following the discovery of the cavity in early March at Davis-Besse, the NRC chartered what's referred to an 0350 Panel. It's a more extensive oversight process for a plant that meets certain criteria and the bases for chartering that panel were that the head degradation issue at Davis-Besse certainly represented a complex and substantive technical issue, but also posed a number of complex regulatory issues and organizational issues for the NRC.

The plant has been in extended shutdown situation with a regulatory hold on that shutdown and that's through a confirmatory action letter. 0350 enhances our ability, as an agency, to define and communicate what we believe are necessary actions prior to restart and it also enhances our ability to coordinate the agency activities in response to the situation at Davis-Besse. So those are the bases for formation of the 0350 panel.

(Slide change.)

MR. GROBE: There's a number of goals that the panel has. The first of those is to ensure that we have a broad and integrated focus on assessment of the facility performance. For a normal plant in an operating configuration that assessment would be under the responsibility of the branch chief and the regional office and the inspection staff that feed into that. In a case like Davis-Besse, we want to have a much more substantive oversight process.

In addition to that, the 0350 panel insures that there's a shared understanding between both First Entergy, the licensee, the NRC and the public on the issues that need resolution prior to restart.

Also, the panel has the capability to break down organizational boundaries in the Agency. We have a number of staffs that are involved in response to this situation to ensure effective and efficient utilization of Agency resources and to minimize the impact on the licensee. The panel is able to bridge those organizational boundaries.

In addition, we've had extensive interface with concerned citizens in the area of the plant, concerned groups of citizens across the country, federal, state and local elected officials, as well as the media and the 0350 panel gives the agency a central focus for a single point of contact on consistent communication with the public.

Two other focus areas, the panel will provide restart -- excuse me, oversight following restart. During the course of an extended shutdown like this at Davis-Besse, part of our normal assessment program includes performance indicators and those performance indicators that are operationally focused will atrophy during the shutdown time frame. So the panel will continue to provide oversight after restart until it determines and recommends to senior agency management that the plant is ready to return to the routine reactor oversight process. And finally, one of the responsibilities of the panel is to create a compehrensive public record, publicly available record of decisions and activities that go into the Agency's actions.

MEMBER LEITCH: John, I'm still a little unclear. Whose approval of the NRC is required for the restart, is it this 0350 panel and the approval chain?

MR. GROBE: No. No. The panel is

chartered by the regional administrator, Jim Dyer in Region III. As far as a restart decision, the panel will go through a structured process to get to a recommendation for restart. That recommendation will be made to Jim Dyer and then Jim's responsibility is in with -- in coordination with Sam Collins, Director of NRR and Bill Kain and Bill Travers, the Deputy DDO and EDO. We'll make the final restart decision.

As far as return to service, excuse me, return to the routine reactor oversight program, again, that's a recommendation of the panel to Jim Dyer and he will coordinate with Sam Collins on that.

MEMBER LEITCH: Okay, thank you.

MR. GROBE: But Jim is the person that makes those decisions.

(Slide change.)

MR. GROBE: The licensee recently submitted on May 21st what they refer to as a return to service plan and that's available on our website. It contains six substantive building blocks. That's how the licensee refers to them. These building blocks form the major tenets of their return to service activities. First one, of course, is restoring the reactor head and they've chosen to replace it. Second is looking at inside containment at the effects of leakage and boric acid and that includes two areas of focus. One is the reactor coolant pressure boundary, the remainder of the reactor coolant pressure boundary beyond the reactor head and the second is other equipment inside containment that could have been affected by the atmosphere that existed in containment.

The third is a system health assurance plan. The focus of that is to examine risk significant systems that are important to plant safety and ensure that, in fact, their operability is where the licensee believes it is. Fourth is referred to as program technical compliance and what that means is are the programs functioning as expected and there's a number of focus areas here, one that the licensee has chosen is the boric acid corrosion management program, of course. Another one is the corrective action program. Both of those programs didn't function as expected, in this case, the design change process and there may be others.

The fifth area is management and human performance excellence plan and I would include organizational effectiveness in this. Clearly, there were some decisions made, judgments made, activities that occurred that involved human performance and that's an area that needs to be addressed. And finally, any necessary testing before restart and then after restart. So those -- hang on for just a second. Those are the six areas.

The NRC will be creating what's referred to as a restart checklist and that will be published, publicly available. The restart checklist will contain these activities and others that the NRC believes are necessary for resolution prior to restart. That would also include, for example, any licensing actions that are necessary or code exemptions and there may be sub-elements in these six areas. These six areas clearly capture the major flavors of what needs to be done before restart. And then our assessment in this context would be to ensure that we're comfortable with the licensee's assessment of root cause in each of these areas; ensure that there are detailed implementation of these activities is going to address those causal factors; and then examine their implementation, both by observing and evaluating what they do and then conducting independent inspections of other areas that they don't cover. And finally, ensuring that any deficiencies identified through the course of these activities are adequately resolved prior to restart, those that need to be resolved prior to restart.

(Slide change.)

MR. GROBE: My final slide is just simply to refresh your memory on what inspection activities are on-going right now. The augmented inspection team completed its work in April. The purpose of the augmented inspection team was a fact-finding mission. It did not put the results into a regulatory context. The AIT follow-up inspection which does that is on-going at this time. We've received substantive information from the licensee on the process they're going to go through to replace the head and we're crafting our inspection plan for that and staffing it right now.

And the extent of condition, these are the activities, the inspection activities that are on-going inside containment. That inspection is also under way.

Are there any questions that I can answer? We covered this in substantial detail yesterday.

Okay, thank you very much.

MR. HACKETT: I didn't get down to as efficient as Bill either, but I hope I can do this in three slides.

Davis-Besse Lessons Learned Task Force.

I'm Ed Hackett. I'm the Assistant Team Leader. Kicked off activities this week on Monday. I guess I'll start with the charter, again, like Jack said, we went into pretty good detail on this yesterday. There are five elements that are listed here. I won't go through those in detail. Only to mention that the focus will be primarily on the top two, the reactor oversight process and regulatory process issues. The team right now is consisting of nine staff from the NRC. It's a mix of managers, technical staff, also representation from all three major offices at the NRC and the regions.

Right now, we're looking at splitting the team two ways. Art Howell is the team leader and Art Howell and some of the regional folks on the team will head a group that will largely interface at the site and with the region and I will head a group here at headquarters that will deal with most of the headquarters' activities.

In terms of schedule, I think Dr. Apostolakis aid to me yesterday, when you're done in six months we'll have a good story. Unfortunately, we need to be done in three months. I think we're probably going to wish we had six months. But the bottom line is we're looking at having to complete this activity by September 3rd with finalization of a report. We're looking at doing it in two phases. As I mentioned, we've only just gotten the team together this week, so we're sort of in a preparation phase right now that includes putting together a lot of the processes and procedures for the group and just getting situated physically. That will probably take most of the month of June. After that, we'll be in a review phase and a report preparation phase that will extend from basically July into September.

A couple of things I mentioned along the way here, there are other activities going on that are related. There is a congressional investigation that's been organized through the Energy and Commerce Subcommittee, United States Congress. That will be going on while this activity is going on also. There's an NRC IG investigation also into certain aspects of the NRC decision making process related to the most recent outage and deferral of inspections at Davis-Besse. So those are going on also. There will be sensitivities and interfaces associated with that in the Davis-Besse task force. There may be things that the task force comes up with that need to get handed off, in particular, to Jack's panel, for instance.

In terms of status, sort of where we are right now, I think I mentioned the top two. Team members are here and physically located at headquarters now, including all the regional staff. There's going to be a lot of coming and going from the site. Team orientation, we had three days of briefings that just concluded yesterday and Jack briefed us for at least three hours, I believe, as part of what his group is doing yesterday. There was a preliminary Region III office visit scheduled for today. That is not happening since several of us are going to be out there next week. The fourth bullet down there, there is a site visit or what we've been calling a public entrance meeting in the site vicinity at Oak Harbor, Ohio. That's scheduled for June 12 and that will be in the morning of June 12. We're basically, we will do kind of what I'm doing here, inform the public and the folks in the vicinity of the plant, of what the task force activities are going to be.

As part of the process, we are conducting interviews with many of the NRC managers, the senior managers. Myself and Art Howell have done a number of those already and several others are in progress and the team right now is preparing detailed review plans.

The last thing I'll mention is to supplement the meting we're going to be having out in the site area next week, we also plan a similar meeting here at headquarters. Right now, we're working towards having that on June 19 and members of the public are welcome and invited to come to that and we will be soliciting any comments on the team's charter at that point and also next week. So that's what I had in the way of status and I'd be glad to take any questions also.

MEMBER FORD: I'd like to thank you very much. I'd like to just say for the public record that yesterday we had a 10-hour meeting in which all of these topics which were covered in the last two hours were very fully discussed, so that will be in the public record.

MEMBER KRESS: One question before we close to the staff, is anybody perhaps in research working on an engineering chemical physical bottle for this wastage problem to try to see if they can predict by model?

MR. HACKETT: I'll go ahead and speak for the Research Office, since that's my home base. Bill Collins is probably the one. I don't know that he's here at the moment. Bill's got the lead for the NRC

Research Office on doing exactly that and it's obviously the problem is defining the task and then getting it done and getting the right amount of resources applied to it I think is going to be one of the key issues.

I think one of the things that's been discussed is obviously a teaming with the MRP to look into doing some more detailed analyses on the cutout from the Davis-Besse head. There have been discussions of mockups for a variety of the mechanisms that have come up and have been discussed here with the Committee. All of that, as my understanding, plans for that are in progress. Bill's branch has put together a user request that's very comprehensive that's been sent to the Office of Research and has been iterated on several times. And again, our problem is going to be time and resources. There's a lot of work I think that needs to be done here and we'll probably be back talking to the Committee about that in the future, but the short answer is yes, that type of work is underway.

MEMBER KRESS: I'd be very interested in that because that's the kind of stuff I used to do, that kind of modeling.

MR. HACKETT: We have the advantage that

a lot of folks want to work on this. It's technically exciting even though it isn't necessarily exciting in the right way for the NRC and the licensee and the public, but there's a lot of very interesting aspects of this technically, so there is going to be a lot of work.

MR. BATEMAN: I would just like to make a point and it's one I tried to make in my brief presentation. My hope is we never have to deal with this situation again and --

MEMBER KRESS: A good model might tell you whether you do or not.

MR. BATEMAN: I'm hoping that an aggressive inspection plan would preclude the need for any angst at all about whether or not this will ever happen in the future.

MEMBER KRESS: I think that would involve, if you saw any leakage at all, regardless how big it was, you have to go in and inspect to see if there's wastage associated with it.

MR. BATEMAN: Right.

MEMBER KRESS: Which may be the solution, you're right.

MR. HACKETT: I think I'd add one more comment just in closing. Allen Hiser yesterday had a presentation that got into discussion of management by leakage and I think we're starting to see that as a theme with some of these recent occurrences when you look back over this progression of D.C. Summer, Oconee, now Davis-Besse. I think some of the discussion yesterday went to the fact that these plants were designed in a very robust way, defense-in-depth, and so on. And for a long time, a lot of this type of situation has been managed through leakage fairly effectively.

What we're seeing now is erosion of these margins and that may not be the prime way of doing this in the future.

MEMBER KRESS: I think the purpose of the research and the model would be two things. One to tell you that you do have to have leakage that's observable in order to get the wastage. That's question one. Question two is how much does the leakage have to be an dhow fast does it progress and so that you can talk about scheduling inspections. I think those two things would be the purpose of developing a good physically based, chemically based model.

MR. BATEMAN: Just another point. I know you have read the root cause report and recognize that they characterize the root cause as a probable root cause with a causal factor being at the blanket of boric acid sitting on top of the head. At this point, we don't know how much of a contribution that blanket of boric acid, crystal sitting on top of the head actually contributed to the corrosion of Davis-Besse. Obviously, other plants had through-wall cracks and didn't have the same amount of wastage around the nozzles, but they also didn't have the blanket of boric acid on top of the head either.

MEMBER KRESS: I would personally think it's not very important but I have a mental model of what's going on.

MR. BATEMAN: Yes. I've talked to a number of people who feel that that blanket on top probably did contribute in some way to the wastage.

CHAIRMAN APOSTOLAKIS: Okay, thank you, gentlemen.

Please come to the microphone. Identify yourself first.

MR. GUNTER: Yes, Paul Gunter with Nuclear Information Resource Service.

A couple of questions. I noted that First Entergy said that they were collecting the boric deposits and they have the cutting of the wastage.

Has staff made a request or is First Entergy offering samples of the cracks in the nozzles themselves? It seems like this would be worthwhile preserving as well and I'm wondering if, in fact, this kind of information is forthcoming.

MR. GROBE: Let me start the answer and then maybe Bill wants to supplement and if First Entergy has any contributions that would be fine, too.

First off, there's very limited amount of the boric acid on the head that was collected. At the same time, these repair activities were going on. The utility was cleaning the head and very little, if any, of the existing boric acid, boric oxide corrosion product blanket on the top of the head was collected. There were some materials collected from the crevice on penetration 2 when that penetration was removed.

By and large, the cracks have been ground out because that's part of the repair process, so they're ground away and there's very little data that can be gained from that. All of these materials have been transported to Lynchburg where they're going to be examined and I think Bill's staff is going to be involved in the decisions of what types of evaluations, destructive evaluations will be undertaken.

MR. BATEMAN: First Entergy has been working very closely with us on the types of analyses, on what types of material to do, so the answer to your question is yes, we are working, First Entergy is working with the NRC to gather as much information as can be gathered from the samples.

MR. McLAUGHLIN: Paul, the process we've been using because all of this material is governed by our confirmatory action letter, there's a section in there addressing quarantine. All of these samples are being handled under the quarantine, so what we've done is we developed, in conjunction with the staff, as well as our root cause team, we develop a written action plan on what's going to be done with those samples and results will be shared with the staff as well as MRP and anyone else who wants those and that will be done, as I described earlier. Right now we have two nozzles in the cavity. We're going to actually make a trip down to Lynchburg, Virginia which is where those three pieces are stored right now and develop a written action plan on where to proceed as far as the testing that's going to be required to provide the industry as much information as we can.

MR. GUNTER: But I guess in gathering --

MEMBER FORD: Excuse me, could you just

identify yourself?

MR. McLAUGHLIN: I'm sorry, Mark McLaughlin, First Entergy.

MR. GUNTER: I gather though that there is some concern with regard to sample size, that is currently available. As far as physical evidence that could be extrapolated further down the line. Am I correct? That --

MR. McLAUGHLIN: Well, the one piece of information that would have been nice and this is one thing that's kind of a thorn in my side because I was the project manager, but the one piece of information that looking back I wish we would have gathered is when we pulled nozzle number 3, the cavity was full of boron. If we had gotten some samples of boron out of that cavity it may have helped preclude some of the need for research as far as -- where there's some unusual chemical components that were at work there and it may have helped develop some of the corrosion rates.

MR. GUNTER: Okay, and just one final question. With regard to the cladding separation issue, I heard this morning that there was no evidence of separation, but that the dye penetrant test didn't do it or wasn't taken, so am I to believe then that the cladding separation issue is inconclusive?

MR. McLAUGHLIN: I've performed visual inspection and the reason that a dye penetrant test has not been done is because there will have to be some machine operation done on the outside diameter of that cavity sample and we will not do anything that would be considered destructive. It would be destructive to do that machining operation and we will not do anything destructive to that sample until a written sample plan has been issued and that's what we're going to be doing in the next two weeks. We're going to get with the staff and take a -- physically look at the cavity and that I would say that's going to be done of the tests that will be performed. However, we're not going to do anything that would destroy any evidence prior to everyone coming to a consensus on a written action plan to do those tests.

MR. GUNTER: Thank you.

MEMBER WALLIS: Now I'm curious. You said the cavity was full of solid material?

MR. McLAUGHLIN: When we pulled -- yeah, when we puzzled nozzle number 3, we had a camera that was underneath the head, so you could see when the nozzle was removed there was now we know it was a boron iron mixture. I guess what --

MEMBER WALLIS: I'm interested in how much water was in there.

MR. McLAUGHLIN: There wasn't anything that ran out. You couldn't tell that there was water there.

MEMBER WALLIS: It could have been --

MR. McLAUGHLIN: It maintained its shape.

MEMBER WALLIS: It could have been liquid boron, but then solidified, but it certainly wasn't in a liquid state at all. It was full of solid.

MR. McLAUGHLIN: That's correct. If you look at the video, it appears that it's carbon steel and you know, if you have an ant farm and you can see all the holes through the glass, that's what it appeared to be because there were so many little fissures and tunnels going through this boron that was -- and that was the pattern that we saw. I mean it really, from the camera view appeared to be carbon steel with some erosion.

MR. GROBE: I believe at that time you were 19 or 20 days after shut down. So for an extended period of time there had been no forcing function to force liquid into that area.

MR. McLAUGHLIN: Right.

MEMBER WALLIS: Yes, but it could have

dried out or something.

MR. GROBE: Right, exactly.

CHAIRMAN APOSTOLAKIS: I think we have to move on. Are there any other comments from the public?

Yes sir?

MR. HORNER: Dan Horner from McGraw-Hill Nuclear Publications.

Yesterday, one of the EPRI representatives made the comment about, I think it was about GEL 8805, that it's a good plan if it's implemented properly. So in that context, I guess my question is as there's been quite a lot of discussion about the inspection plans that are being developed by the industry and NRC. Can someone say what discussion there has been about ensuring proper implementation of them and alternatively, is there consideration of a possibility that the current inspection regime is adequate on paper, but simply has to be implemented and enforced more effectively?

MR. GROBE: A number of responses. First off, as soon as the information notice was issued on precursors to this type of corrosion, specifically the containment air cooler cleanings and the rad monitor filter clogging, I can speak for Region 3. We went back and evaluated those issues at the plants in Region 3. I believe the other regions also did, to confirm that there were no precursors that existed and that's consistent and in line with the activities that Bill Bateman's staff were doing following up Bulletin 2002-01.

Secondly, we talked about paper reviews. Our inspections do involve some paper reviews, but there's much in field activities and independent observations in the field, so it's not just a paper review, that the inspection program does. I believe part of the Lessons Learned Task Force and our Inspection Program Management Branch as well as the Lessons Learned Task Force is evaluating the appropriateness of our inspection activities in these areas and whether they need to be augmented. I don't know if either Ed or Bill want to talk to this.

MR. BATEMAN: The only other thing I'd like to add is that the 60-day response of the Bulletin 2002-01 asks the licensees to discuss their boric acid inspection program, so we do have those responses and are reviewing them at this time.

MR. HORNER: Thank you.

MR. MATTHEWS: This is Larry Matthews from the MRP. Also, the MRP is planning a workshop, I believe some time this summer to get together with all the utilities and look at best practices in the boric acid walkdown program and try and come up with what are the best ways to implement this type of program in the industry and that workshop will be taking place this summer.

CHAIRMAN APOSTOLAKIS: Any other questions or comments from members of the public?

Well, gentlemen, thank you again for coming here.

MR. GROBE: Thank you.

CHAIRMAN APOSTOLAKIS: We'll recess until 11:00.

(Whereupon, the proceedings went off the record at 10:44 a.m. and resumed at 11:02 a.m.)

CHAIRMAN APOSTOLAKIS: Okay. The next topic is technical assessment of Generic Safety Issue (GSI) 189, Susceptibility of Ice Condenser and Mark III Containments to Early Failure from Hydrogen Combustion During a Severe Accident.

Our leader on this subject is Dr. Kress. Tom?

MEMBER KRESS: Thank you, Mr. Chairman.

I remind the committee members that this issue has to do with ice condenser and Mark III containments that during a severe accident will effectively condense the steam and concentrate hydrogen. And in order to control the hydrogen concentrations so that you don't get detonable concentrations, these are -- these type of plants are provided with igniters located throughout the containment area outside the ice condenser chamber and in the drywell for Mark IIIs.

These igniters also have associated with them some fans to be sure you don't -- that the hydrogen can get to the igniters, and that you don't stratify and create pockets of high concentrations.

So the issue is, though, that one of the severe accidents that contributed a great deal to the risk is a station blackout. The igniters and the fans are powered by AC power, and in a station blackout you lose that power. So the issue before us is: should igniters and fans for ice condenser plants and Mark IIIs be equipped with backup power in the event of a station blackout accident.

And this -- if it were so required, this would constitute a backfit. And the staff is required to make a regulatory analysis for backfits. The research has done this, and this will -- what we'll hear about today is the regulatory analysis backfit for possibly some options on backup power.

I would want to point out that on this subject we have received comments from a member of the public, Ken Bergeron, and he couldn't be here today for other commitments, but I think David Lockbaum has agreed to speak to his comments.

And, in addition, we have comments from a member of the public living near Watts Bar, which is an ice condenser plant, Ms. Ann Harris. And I think there is a TVA employee -- I'm sure there is -- Bob Bryan, who would like to make a few comments. So we have a busy schedule ahead of us.

With that, I'll turn it over to the staff to give their presentation.

MR. NOTAFRANCESCO: Al Notafrancesco. I'm Task Manager for GSI-189. We are doing this in the Office of Research. I'm in the Safety Margins and Systems Analysis Branch.

Okay. GSI-189 has to do with Mark IIIs and ice condensers, as said earlier. Basically, in the process of risk informing 10 CFR 50.44, we had a series of Commission papers and gave us the status and the staff plans. We got an SRM December 31st, told us to resolve GSI-189 expeditiously. So that's what we plan to do.

In February 2002, this past February, it passed the generic issue screening process. We quickly generated a task action plan, and we are currently completing a technical assessment. And basically I'm going to present you an overview of the technical assessment.

Just to give a sense of what the population of plants we're talking about, PWRs with ice condenser containments, there's nine reactors, four dual units, one single unit. There's four BWR plants, four single units. In the 1980s, these plans were retrofitted with AC-powered igniters to mitigate the consequences of copious amounts of hydrogen as part of the post-TMI action.

So, but there has always been a long issue about the performance in station blackout, because they're not available, and that's where we're going.

This is just a schematic of the two types of plants. What they have in common -- their pressure suppression containments, their intermediate volumes between 1.2 and 1.5 million cubic feet. One uses ice, one uses water.

MEMBER KRESS: Would you point to where the igniters are likely to be located in those?

MR. NOTAFRANCESCO: Okay. The igniters

are judiciously located pretty much everywhere except the ice chest and the lower plenum here. Everywhere else there is igniters. For the Mark III, there's more igniters, so they're pretty much particularly below the ACU floor where there's potential for hydrogen buildup.

Okay. The objective of this work was to justify if a backup power supply is warranted. Two aspects we looked at -- cost benefit guided by the NRC-prescribed methods.

MEMBER WALLIS: Excuse me. You said just the igniters. How about these fans, which may be a pointed issue?

MR. NOTAFRANCESCO: It's included in here.

MEMBER WALLIS: Do you mean igniters and fans or fans or both or either or --

MR. NOTAFRANCESCO: Well, we've considered the fans, and we feel --

MEMBER WALLIS: You've already discarded them as a need?

MR. NOTAFRANCESCO: Well, I --

MEMBER WALLIS: This just says igniters.

MR. NOTAFRANCESCO: As part of our analysis, we pretty much discarded them.

MEMBER WALLIS: Okay.

MR. NOTAFRANCESCO: We did consider them.

CHAIRMAN APOSTOLAKIS: So the power supply will be to igniters only.

MR. NOTAFRANCESCO: That's the bottom-line recommendation.

CHAIRMAN APOSTOLAKIS: Okay.

MEMBER ROSEN: And you will explain to us why the fans are not needed to --

MR. NOTAFRANCESCO: And we'll get to that. And that's why I have it here. Cost-benefit analysis guided -- based on looking at fans, not --

MEMBER ROSEN: Pardon me. But it's a little bit unclear from that statement that you --

MR. NOTAFRANCESCO: Okay. But here. For ice condensers, perform an updated severe accident analysis demonstrating igniters alone are adequate. I didn't get to that line yet.

MEMBER WALLIS: So your purpose there -- you don't say anything about fans here at all. It looks as if you've already decided --

MR. NOTAFRANCESCO: Fans are imbedded in here.

MEMBER WALLIS: They are? Okay.

MR. NOTAFRANCESCO: But we -- we'll get to it. I'm just trying to walk you through the history a little bit, too, of the action plan. We didn't discard it at the beginning, but as time went on -- okay. So then we executed the task action plan, and then briefing the committee, and we want to send our findings to --

MEMBER WALLIS: It's a poor objective. I mean, it looks as if you're asked to prove that igniters alone are adequate. It's just a poor starting point. It's almost that you start with -- that igniters alone are adequate.

CHAIRMAN APOSTOLAKIS: Well, that was not part of the original objective, I hope.

MR. NOTAFRANCESCO: Well, we've got to understand this is melted with the Mark IIIs, and the fans aren't an issue with that. So the fans are a little issue with ice condensers but not for the Mark III. So we've got to put it in perspective. It's a larger -- dealing with two different classes of containments.

Okay. Our approach for expeditious resolution was to use existing studies and to assemble a support team with contractor assistance. We supplied you about three or four weeks ago a package, and each of the contractors provided a report. And one component is the cost analysis, the benefits analysis, and the plant analysis, specifically on the fan performance and the igniters alone aspects of it.

MEMBER WALLIS: But, again, you say use existing studies. You've got to determine that they're adequate first.

MR. NOTAFRANCESCO: Well, what I -- I'll get to it and try to differentiate. There's some ongoing work. But before I get to the analysis, I'll get to some of the preliminary -- the aspects related to the cost analysis first.

CHAIRMAN APOSTOLAKIS: Now, what percentage of the large early release frequency does the SBO contribute to? Is it one of the major contributors?

MR. NOTAFRANCESCO: Well, hopefully, our benefits analysis will quantify that.

CHAIRMAN APOSTOLAKIS: Well, you'll probably lift it from existing studies. You're not going to do it yourself. That's part of the --

MR. LEHNER: In the --

CHAIRMAN APOSTOLAKIS: Who are you?

MR. LEHNER: John Lehner from Brookhaven National Lab. In the March 3 analysis, which was based on the -- on NUREG-1150, the SBO was 90-some percent of the total core damage frequency. In the ice condensers, it varies, but it's still a significant part of the total core damage frequency.

CHAIRMAN APOSTOLAKIS: But you are not dealing with core damage frequency here. You are really producing LERF.

MEMBER KRESS: That's part of it. Core damage frequency is --

CHAIRMAN APOSTOLAKIS: Yes, but, I mean --

MEMBER KRESS: -- a component of LERF.

CHAIRMAN APOSTOLAKIS: I know. But what was the percentage to LERF?

MR. LEHNER: Well, if you -- for Catawba, the conditional containment failure probability was about .3. So probably about 30 percent of that's SBO frequency.

MEMBER KRESS: Yes, that's not a conditional early, but --

MR. LEHNER: Conditional SBO.

MEMBER KRESS: Yes. But conditional early is a little lower than that, but it's a substantial contribution of the LERF.

MR. LEHNER: Okay. Thanks.

MR. NOTAFRANCESCO: Okay. As part of the cost benefit, we are trying to get a handle of what the cost is and what kind of configuration can one construct that would enhance plant capability. And we've concentrated on a pre-staged design, which is a stationary diesel that could be hooked up when needed, and then we also looked at an off-the-shelf option where a portable generator is put in place with minimum plant modifications. So we're trying to run a gamic of what is an optimal arrangement considering cost.

MEMBER WALLIS: What's the difference? They're both going to be there all the time. It's just that one is cheaper than the other.

MR. NOTAFRANCESCO: Right. But that is needed to --

MEMBER WALLIS: You're not going to move the portable diesel generator around.

MR. NOTAFRANCESCO: Well, the portable diesel generator is hopefully small enough that there will be more of them, and they'll be available --

MEMBER WALLIS: This is one you can buy in a hardware store or something, instead of going to some nuclear supplier.

MR. NOTAFRANCESCO: Right. They will be more of them, more diverse places. There will be more --

MEMBER SIEBER: Does that mean somebody

has to go out and buy these things? Here's an accident. Will you send a clerk down to the store and say, "Get me one of these"?

MR. NOTAFRANCESCO: Well, that's -- they're small. They're about 5 KV generators for igniters.

VICE CHAIRMAN BONACA: Well, I think if I can offer a suggestion, I mean, looking ahead to your slides 14 and 15, they really provide answers to all the questions you are getting right now. I would suggest that you go through this analysis first, and then we'll understand why you're making certain equipment choices.

You know, you have presented some options. It seems to me that those two slides explain why you, for example, feel that igniters alone are effective. And then, in that case --

MR. NOTAFRANCESCO: Well, again, we're isolating on ice condensers. We'll looking to try and do both classes of plants. I'm trying to walk through this.

VICE CHAIRMAN BONACA: All right. I just -- all right. That's fine.

MR. NOTAFRANCESCO: Again, there's the cost-benefit component that's necessary to meet --

VICE CHAIRMAN BONACA: Okay.

MR. NOTAFRANCESCO: -- to promote any sort of backfits. I wanted to just -- I'll quickly go through this thing and --

VICE CHAIRMAN BONACA: Sure.

CHAIRMAN APOSTOLAKIS: So why is the low-cost option more reliable during an earthquake?

MR. NOTAFRANCESCO: Well, okay, that's my next slide. There's some judgment in this. The pre-staged design, if it's designed for external events, clearly, the costs start to skyrocket. We do expect some survivability even -- or a subset of the external events. So it's not going to be 100 percent qualified, but it does provide us some capability.

CHAIRMAN APOSTOLAKIS: So, again, now we're bringing up the issue of external events. How much is -- are these contributing to station blackout?

MR. NOTAFRANCESCO: They could be about a half. External blackouts could contribute roughly a half, I think we assume.

MR. LEHNER: Yes. For the ice condensers, the external core damage -- the external SBO frequency was about two-thirds of the internal station blackout frequency.

CHAIRMAN APOSTOLAKIS: When you say

"external," do you mean earthquakes primarily?

MR. LEHNER: Primarily earthquakes, but I think there is also some high winds. Yes, but it's primarily earthquakes, I believe.

MR. NOTAFRANCESCO: Again, this judgment on the low-cost, no permanent structure, and setup would occur after the initial impact of the external event. Portable diesel may come from multiple diverse locations. Attributes may --

CHAIRMAN APOSTOLAKIS: I don't understand that sentence. Is that clear? No permanent structure, setup would occur?

MR. NOTAFRANCESCO: Well, there's a -- since this option --

CHAIRMAN APOSTOLAKIS: Do you mean damage?

MR. NOTAFRANCESCO: Well, in the pre-staged design, there is the assumption of having a concrete pad and having a small doghouse off the aux building. So it's a permanent structure.

CHAIRMAN APOSTOLAKIS: Oh, I see.

MEMBER ROSEN: The setup would occur after --

CHAIRMAN APOSTOLAKIS: There would be no permanent structure, and the setup would occur after the initial --

MR. NOTAFRANCESCO: Right.

CHAIRMAN APOSTOLAKIS: Oh. See, I'm thinking sometimes --

MR. NOTAFRANCESCO: Well, I'm --

MEMBER WALLIS: The difference is build a building or just wheel up a generator and hitch it down.

MR. NOTAFRANCESCO: Right. I mean, that's what this was. Use of portable with minimum permanent modifications.

Okay. Putting numbers to this concept, we --

CHAIRMAN APOSTOLAKIS: Well, let's understand this a little bit, though. You are saying it would occur after the initial impact of the external events. So we presume that the humans will perform as anticipated, as expected, after a major earthquake? Or you didn't address that issue?

MR. NOTAFRANCESCO: Well, we assumed there will be an army of guys trying to recover from the damage, so --

CHAIRMAN APOSTOLAKIS: And those guys have not been affected by the fact that they have just been through a major earthquake.

MR. NOTAFRANCESCO: Well, you know, we're not saying it's going to be 100 percent effective through all the credible earthquakes, but at least a significant fraction.

CHAIRMAN APOSTOLAKIS: But you have some human reliability numbers in the calculations? Because, I mean, in the one instance you assume that the earthquake will affect the pre-staged design --

MR. NOTAFRANCESCO: Well --

CHAIRMAN APOSTOLAKIS: -- which is reasonable. But then, you know --

MR. NOTAFRANCESCO: Well, we -- in the numbers we do say the reliability of the portable setup is a little less than the pre-staged setup. But we also use judgment to say it may be compensated by the fact that the off-the-shelf approach is more versatility to respond to external events and may compensate for that negative in which --

CHAIRMAN APOSTOLAKIS: Well, there is more versatility, but we are relying now on the crew.

MEMBER LEITCH: You have some considerable time to do this.

MR. NOTAFRANCESCO: Two, three hours, several hours.

CHAIRMAN APOSTOLAKIS: Oh, you do?

MR. NOTAFRANCESCO: Yes. At least

several. It depends on your sequence.

MEMBER LEITCH: I thought I remember seeing 48.

MR. NOTAFRANCESCO: Well, we wanted the --

CHAIRMAN APOSTOLAKIS: Wait a minute. What happens during those 48 hours?

MR. NOTAFRANCESCO: The 48 hours are used as an assumption --

CHAIRMAN APOSTOLAKIS: Are you also in a state of damage to the core? Has the core been damaged?

MR. NOTAFRANCESCO: In these cases they are, because you're trying to deal with hydrogen. You're trying to get the igniters powered.

CHAIRMAN APOSTOLAKIS: Okay. Sure. So the fact that I have 48 hours by itself doesn't --

MR. NOTAFRANCESCO: No, I'm not saying that's --

CHAIRMAN APOSTOLAKIS: -- help me very much because I have a core damage event. So --

MR. NOTAFRANCESCO: You don't have 48 hours. The 48-hour number had to deal with the length of time of putting the diesel in a tank. It was just part of the estimate of having them working for 48 hours after setup. That's where the 48 hours comes in.

CHAIRMAN APOSTOLAKIS: Okay.

MR. NOTAFRANCESCO: But you're in a degraded core -- core melt sequence. You have time to -- to set this up before you -- the hydrogen is generated. That's the concept of --

MEMBER KRESS: There's a station blackout rule that requires the plants to have backup diesels already. These are big diesels to power safety-related equipment. Why can't the igniters and fans be hooked to those diesels?

MR. NOTAFRANCESCO: That could be possible. That could be --

MEMBER KRESS: Was that an option that was --

MR. NOTAFRANCESCO: That could be an option for the utility, clearly. We just crossed it out based on an independent backup.

MEMBER KRESS: An independent backup.

MR. NOTAFRANCESCO: Right. There's other demands on other things. I don't know if we could --

MEMBER ROSEN: The problem, Tom, is if you hook them to the station's safety-related diesels, you're assuming those diesels are not functional in station blackouts.

CHAIRMAN APOSTOLAKIS: Right. They're out.

MEMBER ROSEN: That is the assumption. Station blackout means you don't have AC power either offsite or onsite.

VICE CHAIRMAN BONACA: So you have the station blackout, and now you have core damage, and you have hydrogen.

MEMBER ROSEN: Now, the question is: why would you assume, given that, that these would work? I mean, don't you then say it'll be -- there's another layer through --

VICE CHAIRMAN BONACA: Right.

MEMBER ROSEN: -- but it -- one says with the assumption of station blackout it means you don't have AC power. And here you say, okay, we're going to provide AC power.

VICE CHAIRMAN BONACA: Well, I mean, do you have a redundant system, an additional system? I mean, how many layers are you going to --

MEMBER ROSEN: I understand. I understand that this is --

CHAIRMAN APOSTOLAKIS: No. But, I mean, the reason why you are in an SBO situation is that something very dramatic has happened.

MEMBER ROSEN: Exactly.

CHAIRMAN APOSTOLAKIS: And I think the question, you know, why should these additional diesels survive, then, is a good one.

MEMBER ROSEN: Well, and I think the focus on earthquakes is completely wrong. I mean, the issue is not really earthquakes, although that's one of the ways you could get to station blackout. But, you know, high winds and flood are -- seem to me also very important.

CHAIRMAN APOSTOLAKIS: Yes. They mentioned that they are -- those are --

MEMBER WALLIS: I have another question. Why does the diesel have to run the 48 hours? Because the igniters are only used once, aren't they? You need a certain amount of --

CHAIRMAN APOSTOLAKIS: Well, no, no, no.

MEMBER WALLIS: -- energy, or do you keep them clicking away all the time?

CHAIRMAN APOSTOLAKIS: That's not what he said. He said you have 48 hours to connect to diesel.

MEMBER ROSEN: Allen, do you want to try again?

MEMBER WALLIS: He needs a tank. He's going to --

MR. NOTAFRANCESCO: The tank of 48 hours was just an assumption just to come up with an estimate. It could be even less than that. But the costs associated with a tank covering 48 hours or 24 hours is quite small.

MEMBER WALLIS: It reminds me of something that goes off all the time.

MR. NOTAFRANCESCO: That continuous hot points --

MEMBER WALLIS: Continuous operation. Okay. Okay. It's not something that senses --

CHAIRMAN APOSTOLAKIS: Anyway, can we go back to seven, because I don't think I got an answer to my question. This seven. You have in there the study that you guys did has some probabilities that a setup would not be correctly done?

MR. NOTAFRANCESCO: Yes.

MR. ROSENTHAL: Can we just play -- this is Jack Rosenthal. You or I -- I think we need, just so everybody is clear, at time T zero you have Hurricane Andrew hit, or you have an earthquake hit, etcetera, real events that cause loss of offsite power. You hypothesize common mode failure of the diesel generators. The source of the power would be diverse, not subject to that common mode which would dominate the event.

Given blackout, either several hours will go by in which you live off your batteries, your station battery, six, eight hours, with supplying water to your steam generators from your steam driven auxiliary feedwater pumps, or sometimes people will postulate failure of that steam driven pump which moves the sequence up in time.

At some point, so many hours into the event, you start uncovering the core, heating the core, generating hydrogen. You'd like the igniters to be continuously powered, so that they can burn off the hydrogen in small amounts over a period of hours that's being created. And the emission time for this whole process that was assumed -- that's the 48 hours that he's talking about in which -- during which, you know, it's -- one could be -- so we -- I --

CHAIRMAN APOSTOLAKIS: I understand that.

MR. ROSENTHAL: -- I just wanted some clarity on the sequence.

CHAIRMAN APOSTOLAKIS: How much time do I have?

MR. ROSENTHAL: To start.

CHAIRMAN APOSTOLAKIS: To start.

MR. ROSENTHAL: Well, if the batteries are running and the auxiliary feedwater pump is running, then things shouldn't get bad for, let's say, eight hours.

CHAIRMAN APOSTOLAKIS: So I can stop having those --

MR. ROSENTHAL: But that's not to say that the station crew would be dedicating its resources to getting this little generator connected up. I would think that they would be dedicating their resources to getting the main power back on. So at some point in the process, the tech support center, the coping crew, makes the decision that they have to divert resources to get out to do these heroic actions and somehow get this alternate source connected. I think that a .8 was assumed.

MR. MEYER: Yes. Jim Meyer from ISL. The low-cost option has some down sides, and the functional reliability we're assuming for that was about .8. The majority of --

CHAIRMAN APOSTOLAKIS: And .8 is the probability that they will do it successfully.

MR. MEYER: Yes. It would be the non --

CHAIRMAN APOSTOLAKIS: Within whatever, four, five, six hours.

MR. MEYER: Within the required period of time, which we were given guidance on as being between two and four hours. The --

MEMBER ROSEN: How does that compare to the higher cost option?

MR. MEYER: Yes. The pre-staged we were assuming a reliability of about 90 percent. And the difference between the 90 percent and the 80 percent is basically the human reliability issue because the pre-staged is a matter of -- of everything is set up ahead of time.

You really have to initiate the start of the generator and hook up to the igniters, whereas the low-cost option you have to actually move the generator to the place where it's to be hooked up to the igniters and then power the igniters. So we were assuming --

CHAIRMAN APOSTOLAKIS: You didn't do any uncertainty analysis? I mean, it was a point estimate based --

MR. MEYER: We didn't do any uncertainty analysis.

VICE CHAIRMAN BONACA: Would you have better survivability for the low cost, given that you can utilize protected areas to maintain it rather than the installed one, which is going to be installed in some area where, as you are saying, because of cost reasons you are not protecting it as well. I'm just asking if the protection issue is considered here.

MR. MEYER: Well, you're talking now about external events?

VICE CHAIRMAN BONACA: Yes.

MR. MEYER: The context of external events?

VICE CHAIRMAN BONACA: Yes.

MR. MEYER: Well, the pre-stage that we analyzed, we analyzed both assuming only internal events and then we considered the added cost of external events. For low cost we didn't do that type of direct analysis.

But these low-cost options have a history of being very robust and capable of accommodating, for example, vibrations from seismic events. So the expectation is a combination of robustness of the devices and their location would allow for accommodation of some external events that pre-stage wouldn't.

VICE CHAIRMAN BONACA: And so that's why I was asking the question, because I can imagine that when you were making a point in the pre-stage cannot be totally protected because the cost would be excessive, so you have -- a more costly option, however, is not fully protected.

And then that's why I was trying to understand the least expensive option, which is portable can be better protected because you can put it somewhere where you have protection. So it is an issue that is not reflected in the .8 -- or .9, is it?

MR. MEYER: The .8 and .9 were just assuming internal events.

VICE CHAIRMAN BONACA: Doesn't reflect that issue. Okay.

MEMBER WALLIS: .8 to .9 is just pulled out of the air? The actual reliability of the generator used in a construction trade is probably 99 percent.

MR. MEYER: The reliabilities of the actual generator are very high.

MEMBER WALLIS: Yes. Very, very high.

MR. MEYER: It's a combination of the reliability -- the unreliability, unavailability, and the human factors.

CHAIRMAN APOSTOLAKIS: The human factors.

MR. MEYER: The human factors drives both numbers.

CHAIRMAN APOSTOLAKIS: Now, why do you

have to move it you say? I mean, why isn't it where it's supposed to be already?

MEMBER ROSEN: Well, that's one option, right?

MR. MEYER: No, this is the pre-staged --

CHAIRMAN APOSTOLAKIS: No, the portable.

MR. MEYER: Let me point out that we're not trying to do a future licensee's work in designing a system. We're just doing a feasibility study that said if you were to have a five, seven kilowatt pre-staged diesel in some sort of doghouse, or if one were to have a fancy Honda generator on the back of a pickup truck, what might it cost, and how efficacious might it be, with the details of the design left to the -- to some future licensee, should they be required to do this?

So, and what we recognized -- what it was -- I think that Honda generators, or whatever they are on the back of pickup trucks, are very reliable. They get bounced around all the time. The workman throws it off the back of the truck, drops it on the floor, pulls the ripcord, and the thing starts.

However, he's got to think to do it. He's got to divert scarce crew resources to take the action. He's got other parities to do. You've got to get this thing started, and then somehow you've got to get power -- some temporary rig of power onto the switch gear, which is going to the igniters. And it's all those human actions that would dominate.

CHAIRMAN APOSTOLAKIS: Okay. Let's move on.

MR. NOTAFRANCESCO: Here are the specific numbers of the low-cost option ice condenser, Mark III, pre-staged, and the difference here is basically to accommodate multi -- two-unit sites in which you could share some costs in the pre-staged. Again, Mark IIIs, they are only single-unit plants.

Also, give you a sensitivity if we were to make the pre-staged more robust to deal with external events. You can see the cost dramatically starts to go up.

MEMBER ROSEN: What does this "with ext-qual" stand for?

MR. NOTAFRANCESCO: External qualification.

MEMBER ROSEN: Qualification against external events.

MR. NOTAFRANCESCO: Right. It's just maybe several times a factor on the baseline cost.

MEMBER WALLIS: It's also the generator is only like $2K, I got from your report, so the rest of it is --

MR. NOTAFRANCESCO: Well, there's a lot of components to an engineering installation.

MEMBER WALLIS: So it's not just going to be driven off and take -- it's going to be --

VICE CHAIRMAN BONACA: I don't understand. You are showing there NRC?

MR. NOTAFRANCESCO: Yes, the NRC --

VICE CHAIRMAN BONACA: That's -- okay, that's --

MR. NOTAFRANCESCO: There's two components.

VICE CHAIRMAN BONACA: I understand now.

MR. NOTAFRANCESCO: Industry, of course, and it's in the document, and NRC. And the assumption here is that the rulemaking, of course, associated is minimal. But it's --

CHAIRMAN APOSTOLAKIS: So we do things that cost only $13,000. There are certain things we do that cost only $13,000?

MR. NOTAFRANCESCO: Well, that's why this is -- we're linking it on this.

MEMBER WALLIS: This is per installation. This is for the whole fleet.

MR. NOTAFRANCESCO: Per unit. This is per unit.

Okay. Now the benefits analysis on ice condensers and the Mark IIIs. This is the cost; this is the benefit component. What we did, again, to expedite this, we -- and to use existing information, we have -- the agency is required, as part of the license renewal, to have -- to look at severe accident mitigation alternatives.

And as coincidences the past few months took place, we understood that the Duke plants, McGuire and Catawba, came in with submittals. And one of the alternatives is looking at backup power to the igniters and fans. So we looked at their averted costs, and that's where I get this table from is that.

It's plant-specific based on the PRA. It was contrasted against an NRC or a Sandia report on using different containment conditional failure probabilities. And here's the sensitivity associated with it. These costs -- they look at discount rates. The base is seven percent. Three percent is the sensitivity, and looking at useful --

CHAIRMAN APOSTOLAKIS: What exactly are you calculating?

MR. NOTAFRANCESCO: You are converting the person rem of -- the averted person rem to a monetary cost.

CHAIRMAN APOSTOLAKIS: But in the report it also says that you are looking at land contamination.

MR. NOTAFRANCESCO: That's filtered into this, right?

MR. LEHNER: There are offsite property costs that are --

CHAIRMAN APOSTOLAKIS: No, no, no. You have to come up here. You have to go to a microphone somewhere.

MR. LEHNER: John Lehner from Brookhaven. There are offsite property costs that are in addition to the $2,000 per person rem calculation.

CHAIRMAN APOSTOLAKIS: Right. So these are here?

MR. LEHNER: These are included, yes.

CHAIRMAN APOSTOLAKIS: Okay.

MR. LEHNER: So it's both the $2,000 per person rem costs as well as the monetary costs for evacuation, cleanup, decontamination, whatever.

CHAIRMAN APOSTOLAKIS: So you assume a certain period of years that will be required to decontaminate some --

MR. LEHNER: Yes. Actually, those costs are based on the consequence analyses that were done with NUREG-1150 for an ice condenser plant, and for -- well, in this case, for the ice condenser plant. Yes.

MEMBER KRESS: There's a NUREG document that tells how to -- gives real guidance on how to convert this cost and discount it for current worth. And we reviewed that one time and passed judgment and said we thought that was good guidance. And they followed that NUREG guidance.

CHAIRMAN APOSTOLAKIS: But did both the licensee's and the NRC's analysis consider the same kinds of costs? Because the difference is fairly large.

MR. NOTAFRANCESCO: This in here?

CHAIRMAN APOSTOLAKIS: McGuire in the NUREG, yes. Are you looking at the same --

MR. NOTAFRANCESCO: Well, this is a plant-specific, and this was a sensitivity that Duke did based on the conditional probabilities included in this NUREG.

CHAIRMAN APOSTOLAKIS: Sensitivity, where is it? No, it's discount rate.

MR. NOTAFRANCESCO: Well, the discount rate is based in here.

CHAIRMAN APOSTOLAKIS: The range. So even the high point, $248K, is significantly lower than the $678K.

MR. LEHNER: Can I maybe explain that?

CHAIRMAN APOSTOLAKIS: Yes.

MR. LEHNER: I think the -- what you're looking at in that table is -- both of those columns are the plant's calculations. Right, Allen?

MR. NOTAFRANCESCO: Right. Yes.

MR. LEHNER: No, both. The left and the right. The difference is that in the right column they use the failure -- the containment failure probabilities from NUREG/CR-6427. The NRC calculations actually -- or the calculations that were done for NRC by BNL are not shown there. They are similar to what on the right.

CHAIRMAN APOSTOLAKIS: Oh. So this is both for the licensees.

MR. LEHNER: Right. And the difference -- I think the main difference is that they used containment failure probabilities reported in NUREG-6427.

CHAIRMAN APOSTOLAKIS: And in the first one they use their own.

MR. LEHNER: Yes.

MR. NOTAFRANCESCO: But in your work you confirm pretty much it's --

MR. LEHNER: Yes.

MR. NOTAFRANCESCO: -- high up there anyway, and that's what I said.

MR. LEHNER: It's pretty similar to that, yes.

MR. NOTAFRANCESCO: But it had nothing to do with the -- I mean, the variation has to do with discount rate.

MR. LEHNER: Right.

MR. ROSENTHAL: Excuse me. George, just to be absolutely sure, take the core damage frequency attributable to station blackout, multiply that by the delta change in containment failure attributed to whether you're going to have igniters or not, calculate the associated person rem for that event, and then convert that to dollars. So we're looking at averted person -- monetized averted person rem incremental.

CHAIRMAN APOSTOLAKIS: Plus contamination.

MR. ROSENTHAL: Yes.

CHAIRMAN APOSTOLAKIS: Yes.

MR. ROSENTHAL: Okay.

CHAIRMAN APOSTOLAKIS: Yes, I understand.

MR. NOTAFRANCESCO: That was the ice condenser summary. This is the Mark III. Since we didn't have SAMAs and plant-specific numbers probably to work on, Brookhaven used the IPE specific to Grand Gulf, took the perspective and insights from 1150, and came up with a range of averted monetized costs.

CHAIRMAN APOSTOLAKIS: Now, give me an example of an early failure that is averted. You say all early failures are averted.

MR. NOTAFRANCESCO: Due to hydrogen combustion. Any --

CHAIRMAN APOSTOLAKIS: Yes. I mean, what kind of failures are we talking about? How they --

MR. NOTAFRANCESCO: Containment failures. That means they are early containment failures.

CHAIRMAN APOSTOLAKIS: Oh.

MR. NOTAFRANCESCO: They are early containment failures. Again, early failures are specific to the generic issues. The title of the generic issue is early --

CHAIRMAN APOSTOLAKIS: So you are eliminating early containment failure, right? That's what you're saying?

MR. NOTAFRANCESCO: Well, that's --

CHAIRMAN APOSTOLAKIS: From hydrogen

combustion.

MR. NOTAFRANCESCO: Right.

CHAIRMAN APOSTOLAKIS: Okay.

MEMBER SIEBER: But if the igniters --

CHAIRMAN APOSTOLAKIS: So it's not all of them, just --

MR. MALLIAKOS: This is Asimios Malliakos from the staff, Research. We don't completely eliminate failures. I mean, we don't go completely down to zero. But let me give you an example. Let's say we have an RCS pressure at vessel break, lower RCS pressure. We can drive the probability from .2 to .01. So it doesn't go completely down to zero.

CHAIRMAN APOSTOLAKIS: And there is a rationale why you do that.

MR. MALLIAKOS: There is --

CHAIRMAN APOSTOLAKIS: Why is it .01? There must be some other possibility of failure, right? You are eliminating the failure -- you are reducing it by the probability of failure due to hydrogen.

MR. MALLIAKOS: Yes. Yes.

CHAIRMAN APOSTOLAKIS: So there are still other causes. That's what you're saying, and that's what --

MR. MALLIAKOS: That's right. We have direct containment heating. We have other events that take --

CHAIRMAN APOSTOLAKIS: Okay.

MEMBER KRESS: Okay. That's high pressure melt for --

CHAIRMAN APOSTOLAKIS: Not here.

MEMBER KRESS: Not very likely for Mark IIIs, but --

CHAIRMAN APOSTOLAKIS: Not in these containments, right? That was the whole point.

MEMBER KRESS: Well, yes, they are potential issues for both containments.

CHAIRMAN APOSTOLAKIS: Yes, John.

MR. LEHNER: Actually, let me make another clarification here. In the Mark IIIs, the igniters don't eliminate all early failures from hydrogen. In the high pressure scenarios, the vessel fails at high pressure. Then, at least according to the 1150 analysis, the igniters will not eliminate the --

CHAIRMAN APOSTOLAKIS: Do you still have high pressure scenarios?

MR. LEHNER: You still have high pressure scenarios, because in a -- you know, when you lose -- in a station blackout you will lose the ability to depressurize the vessel. And, therefore, you will have high pressure scenarios, in which case you have a whole bunch of other mechanisms that come in. One of them is DCH steam explosion.

CHAIRMAN APOSTOLAKIS: I thought that high pressure scenarios had been eliminated.

MR. LEHNER: Not for station blackout, because you eliminate -- you lose your ability to depressurize.

MEMBER WALLIS: This is something that hasn't been through a subcommittee?

MEMBER KRESS: No, we didn't have a subcommittee on this one.

MEMBER WALLIS: So no subgroup of the committee has had a chance to really dig into the rationale for all of these things?

MEMBER KRESS: Other than we were supplied with the documentation to read.

CHAIRMAN APOSTOLAKIS: So the dominant contributor is -- in station blackout is low pressure scenarios, but the others are not eliminated.

MR. MALLIAKOS: Yes. That's for the averted benefit. That's the low pressure.

CHAIRMAN APOSTOLAKIS: Okay.

MR. MALLIAKOS: The high pressure, it

doesn't make much of a difference. There is no difference.

CHAIRMAN APOSTOLAKIS: But it's not a major contributor here on these containments.

MR. LEHNER: No, it is. I mean, one of the reasons why you see less of a benefit for the Mark IIIs is because the igniters will only help you in the low pressure scenarios, and the high pressure scenarios will not benefit from the igniters. That's why you see a much lower benefit here than you did for the ice condensers.

CHAIRMAN APOSTOLAKIS: It would have been nice to see some event trees here, you know? But it's too late now.

MEMBER KRESS: They're in the document.

MR. NOTAFRANCESCO: They're in the document.

CHAIRMAN APOSTOLAKIS: Well, this information is in the document, too, right? And yet it is also on slide 10.

MR. NOTAFRANCESCO: I'll talk to Asimios later.

I just want to give a sense of looking at other plant-specific parameters that are important to the values of monetized benefit, and looking at the other three Mark IIIs, give you a sense that Grand Gulf is on the low range compared to these guys -- these other -- so we're looking at a plant-specific sample, but we're trying to look at the whole range of plans by something like this.

CHAIRMAN APOSTOLAKIS: What's the SBO frequency ratio?

MR. NOTAFRANCESCO: In relationship to Grand Gulf, since we did those calculations based on Grand Gulf, we wanted to see what other parameters will affect the monetized cost. And one of the things is the SBO ratio, and it's the population -- the difference in population and frequency will influence those numbers.

And on the cost-benefit analysis, this is many lines here. Basically, what I did here was put the benefits on top, the different ranges for the classes of plants. The relationship of the low cost and the pre-stage fix if one included external qualification of fans were more in this range. And this is why we gravitated to the low-cost option is there's margin related to the ice condenser, but it's marginal with the Mark IIIs, at least for some of them.

MEMBER WALLIS: What's the benefit to

NUREG-6427? I don't understand that.

MR. NOTAFRANCESCO: Well, that's been quoted a lot, so I just put it in here as a sensitivity.

MEMBER ROSEN: Pardon me, but I'm used to benefit to cost ratios, where one has a number.

MEMBER KRESS: That's a ratio.

MEMBER ROSEN: This is incomprehensible to me, this slide. Is it two to one or three to one or four to one or some -- 10 to one?

MR. NOTAFRANCESCO: Well, we're trying to explain it as uncertainties here. There's uncertainties in how one could come up with this, uncertainties here. There's uncertainty in how this was derived.

CHAIRMAN APOSTOLAKIS: I guess if you look at it, you are comparing the upper --

MEMBER KRESS: The location of the upper with the lower.

MR. NOTAFRANCESCO: Right.

CHAIRMAN APOSTOLAKIS: So what you're saying is that the one that passes the test is the one where the lower part, the cost --

MEMBER KRESS: Is to the left.

CHAIRMAN APOSTOLAKIS: -- is to the left

of the benefit.

MEMBER KRESS: Right.

CHAIRMAN APOSTOLAKIS: And the only one that does that is the low cost.

MEMBER KRESS: Right. The cost benefits, and then for ice condensers. It's marginal for Mark IIIs, but it's clear for ice condensers.

CHAIRMAN APOSTOLAKIS: But for Mark III even those still --

MEMBER KRESS: It's still -- they call it -- it depends on the range.

CHAIRMAN APOSTOLAKIS: But this range is only due to the range -- not the real uncertainties, is it?

MR. NOTAFRANCESCO: The range is due to the types of plants, the Grand Gulf --

CHAIRMAN APOSTOLAKIS: Oh.

MR. NOTAFRANCESCO: That was my previous slide, which I have the different factors involved. Those factors were the multipliers to the $40K, and that's how I get the close to 200-plus.

CHAIRMAN APOSTOLAKIS: How does that work, by the way? I mean, on a generic basis --

MEMBER KRESS: I would have gone ahead and added them up, and added up the cost for each one, and looked at the total sum.

CHAIRMAN APOSTOLAKIS: But is this cost-benefit analysis done on a generic basis or a plant-specific?

MEMBER KRESS: Well, it's -- they try to do it on plant-specific because you're going to have specific plants that this backfit will apply to. So you have to take into consideration those specific plants, but you try to do it for that group of plants in a generic sense.

CHAIRMAN APOSTOLAKIS: Yes?

MR. ROSENTHAL: Let me just try a little bit. What we tried to depict as a bar for the ice condenser plants is a range of initiating frequencies and associated consequences for the range of ice condenser plants. For this large bar, NUREG/CR-6427, there's a study that was done on direct containment heating.

And that used a range of initiating event frequencies extracted from the NUREG-1150. No, I'm sorry, from the NUREG-1150. The ice condenser bar is a range from their own IPEs or their own plant-specific estimates.

On the costs -- so it tries to consider the range as a function of the plant. On the cost side, it's very difficult to come up with -- on a plant-specific basis, one plant might be $60K, and another plant might be $80K. I think you're just tricking yourself. Nobody really -- you know, one could estimate the cost, but one full well knows that when you go build these things that the cost can have a considerable range.

And so what you'd like to believe is that the -- is that your decision is reasonably insensitive to the variability in the assumptions. And the argument is made that the low-cost option for a range of what you think the cost might be is less than the range of benefits that you think that you'd get -- than the range of benefit. That's all you're trying to say.

MEMBER KRESS: Now, would you explain the -- with the external qualification, or with fans, does the "with fans" mean the low-cost option?

MR. NOTAFRANCESCO: No, it's centered with the pre-stage. When fans are involved, you need much more power, and nobody is going to lug a portable diesel around. So it's tied to the pre-stage configuration.

MEMBER KRESS: If you had to supply power to the fans, you wouldn't use a portable is what you're saying.

MR. NOTAFRANCESCO: No, it's more -- a larger capacity diesel. I was just using this as a sensitivity in relationship to the other possible options here.

CHAIRMAN APOSTOLAKIS: Given the plant-to-plant variability, I want to understand that. Maybe you answered it, Jack, but when you -- if you guys decide that, yes, installing the low-cost option is cost beneficial on a generic basis, would there be some plants out there that would do the same analysis, and based on their numbers would show that it's not cost beneficial for them and they would be exempted, or that's not allowed?

MR. ROSENTHAL: It wouldn't be allowed. Number one, it wouldn't be allowed because it's a generic rule.

CHAIRMAN APOSTOLAKIS: It's a generic.

MR. ROSENTHAL: Okay. But now look at -- the bar on the ice condenser, okay, it's the range of ice condenser plants. And what we're arguing is that the low-cost option is by about a factor of three or four better --

CHAIRMAN APOSTOLAKIS: So you don't expect that to happen.

MR. ROSENTHAL: -- for the range of plants.

CHAIRMAN APOSTOLAKIS: Right. So, okay. Right. Is that something you apply to all cost-benefit analyses or for a range of plans, whatever option you are considering must be clearly beneficial? What if it's beneficial for 60 percent of them? Then, you cannot do anything about it, right?

MR. ROSENTHAL: No. Then, one should do a regulatory analysis. Okay?

Allen, just leave it up for a second.

When we were discussing this -- okay. Cost-benefit analysis is clearly a risk-based exercise.

CHAIRMAN APOSTOLAKIS: And it's different from regulatory analysis.

MR. ROSENTHAL: We are supposed to be risk-informed.

CHAIRMAN APOSTOLAKIS: Right.

MR. ROSENTHAL: So one of the inputs to a risk-informed decision process that you would do in a reg analysis, okay, is you would say things -- okay, I have my cost benefit analysis. I have -- do I want some degree of regulatory clarity, regulatory coherence?

Does it make sense to have different requirements for ice condensers in Mark IIIs given that the underlying issue is hydrogen generation? And so that a risk -- in our view a risk-informed decision would be to have a requirement for the Mark IIIs and the ice condensers.

One could argue that on a strictly risk-based basis you don't make the argument on the Mark IIIs.

CHAIRMAN APOSTOLAKIS: Okay.

MEMBER LEITCH: Can we talk a little bit about the fuel for this thing? Have we thought about fire hazards associated with that? I mean, I guess in the low-cost analysis we're picturing a doghouse someplace out in the field with this diesel on wheels, right, and probably a 55-gallon drum on wheels? Is that the picture? No additional fuel in the reactor building?

MR. NOTAFRANCESCO: I don't think we're specific on that. Are we?

MR. MEYER: We considered the fuel --

MR. NOTAFRANCESCO: This is the low-cost option.

MR. MEYER: We considered the fuel requirements for both the pre-stage and for the portable options, and, for example, chose the diesel as compared to gasoline type of generators because the plant would be familiar with the safety precautions associated with diesel.

MEMBER WALLIS: Is this winter diesel or summer diesel fuel?

MR. MEYER: I'm sorry?

MEMBER WALLIS: Is this winter diesel or summer diesel fuel? If you have a diesel machine, you have to change your fuel in the winter in certain parts of the country. Otherwise, it won't work.

MR. MEYER: Well, that -- we didn't take that into account.

MEMBER WALLIS: I mean, there are certain things associated with running a diesel machine, which give rise to extra costs, like changing of fuel every year and making sure it runs and maintaining it.

VICE CHAIRMAN BONACA: Would you have the procedures on how to connect it? I mean, I'm beginning to get concerned about, you know, pre-staging sounds like some kind of operation where it's wired and connected and there are procedures and switches. And this thing here is sitting out there on some kind of track, and somebody has to make a guess on what -- I mean, what do we mean it's not pre-staged?

MR. MEYER: Part of the cost analysis was to -- in addition to the implementation cost was to consider the operational costs to the industry, to the licensee, and that included maintenance costs, training, all that would go into maintaining the availability of that piece of equipment when it would be needed. So that was all folded into the analysis and is part of our report.

VICE CHAIRMAN BONACA: You know, if you have no procedures in place very specific, if you have no clear understanding of the fuel for summer, winter, all these kind of things, you know, I don't give you the .8 credit, because you may have a measured event out there that creates such a confusion that in addition to that we have to have people guessing on what they have to do or so -- I mean, sure, I am comfortable about the set of estimates that you are giving out.

MR. MEYER: Well, as I said earlier, there are definite down sides to the portable low-cost option. And it would have to be worked out through proper procedures to make sure that this was an effective alternative. The actual hookup to the igniters themselves isolating the 1E class system in an appropriate way, all that would be done and installed ahead of time. It would be the actual -- moving the portable diesel to the site and the hookup that would be part of the --

VICE CHAIRMAN BONACA: So you have a degree of pre-staging already. You have a location where you have to bring it.

MR. MEYER: Oh, yes.

VICE CHAIRMAN BONACA: So specifically -- okay. So that's --

MR. MEYER: And that's all been part of the cost analysis. That was included in the cost analysis.

VICE CHAIRMAN BONACA: I think it is an important element that you are not -- you have already pre-staging of a kind.

MR. MEYER: Yes. It would be semi pre-staged.

MEMBER LEITCH: You got off -- you were going to answer my fire question, I think, and you got kind of off that. In other words, tell me where this fuel is going to be stored in the low-cost option and in the pre-staged option.

MR. MEYER: Well, the pre-staged option, the -- what was envisioned would be a fuel storage tank right next to the actual steam -- the actual diesel generator. For the portable, it would have to --

MEMBER LEITCH: That would be in the reactor building? This one?

MR. MEYER: This would be in a separate -- it's been referred to as a doghouse, a separate facility located outside the auxiliary building or the reactor building.

MEMBER LEITCH: Okay.

MR. MEYER: For the portable, the fuel storage would -- we would envision it to be part of the normal diesel fuel storage, and have that diesel fuel available for the purposes intended, for use with the diesel.

MEMBER LEITCH: So you have this event, and then the -- you -- from the main diesel tank or the day take, or something like that for the main diesels, you fill up a 55-gallon drum and wheel it up to the location and wheel up this portable diesel to the location, and by a pre-established set of procedures you connect this to the fuel, you connect this --

MR. MEYER: Yes.

MEMBER LEITCH: -- to the electric somehow by -- you know, you know exactly what you're going to do, you've practiced this, you connect --

MR. MEYER: Our procedure is in having that part pre-staged you would have -- you would be able to hook up to the igniters and be consistent with conforming to the isolation of the 1E system. You know, that's an important part of that.

MEMBER LEITCH: And while this is actually in use, you would then have this 55-gallon drum, if you will, of fuel in the reactor building?

MR. MEYER: It depends on where you would have this hookup.

MEMBER LEITCH: Yes. But it's hard to imagine it being other than that.

MR. MEYER: That would be an issue -- an issue that would have to be contended with. That would be an important down side consideration.

MEMBER SIEBER: Sir, could you state your name and affiliation for the record?

MR. MEYER: Yes. Jim Meyer from ISL. I should comment, too, that at some sites these type of portable capabilities are already in place, and in other sites they will be implemented as part of license renewal considerations of the severe accident mitigation alternative fixes. So these type of considerations have been thought through before for licensees.

MR. NOTAFRANCESCO: This is a cost-benefit summary. The first bullet has to do with the ice condensers. Clearly, it's cost beneficial for the low cost and with potential attribute of having -- of better dealing with external events.

Mark IIIs, it's marginally cost beneficial. Some are more cost beneficial. Some plants -- some are close. Our recommendation was to send the issue over to NRR to pursue further regulatory action.

CHAIRMAN APOSTOLAKIS: What does that mean?

MR. NOTAFRANCESCO: As part of the generic issue process, we've done our technical assessment. It'll go over to NRR, and they may do a regulatory analysis, whatever.

MEMBER KRESS: This is the type of -- NRR can make a regulatory analysis of whether or not it complies with the rule.

Let me be clear. Your analysis shows that if you wanted to power fans as well as igniters, that you would have to use a more rugged pre-staged unit because the fans require a lot more power than the igniters do.

MR. NOTAFRANCESCO: Right. About five times more.

MEMBER KRESS: Yes. And that if you had had that option of those two together, it doesn't pass the cost-benefit test that you give it.

MR. NOTAFRANCESCO: Right.

MEMBER KRESS: Okay. Now, the other question I have is --

MR. NOTAFRANCESCO: It's illustrated here?

MEMBER KRESS: Yes. I don't know if you have a slide on it or not, but I would be interested in seeing the calculations -- I guess they are done with CONTAIN probably or MELCOR -- that shows the hydrogen concentrations in the various control volumes as a function of time for a station blackout event with the igniters operating.

MR. NOTAFRANCESCO: Right.

MEMBER KRESS: Okay. Do you have that anywhere, or do you --

MR. NOTAFRANCESCO: I could go through that. I'll be using the plots that are in your packet.

MEMBER KRESS: Yes.

MR. NOTAFRANCESCO: Well, before we go to that, how about let me give you some of the overview before --

MEMBER KRESS: Okay.

MR. NOTAFRANCESCO: There's only a few slides here.

MEMBER KRESS: Okay.

MR. NOTAFRANCESCO: And the third component, as I said, we're having Sandia using MELCOR to do the containment analysis aspects, igniters alone, igniters with fans. As part of the new 50.44 hydrogen source terms, we are feeding on this work in -- by looking at the containment response aspects of it. And as part of this, they're looking at different uncertainty studies on the hydrogen release rates and sequences.

MEMBER WALLIS: So this is a new study?

MR. NOTAFRANCESCO: Well, this study is within a year. It's still ongoing.

MEMBER WALLIS: And it replaces the 6427 containment study?

MR. NOTAFRANCESCO: Well, our MELCOR study effectively does that, right.

MEMBER WALLIS: It replaces it?

MR. NOTAFRANCESCO: It updates it with the latest hydrogen source terms and a more definitive containment analysis.

MEMBER WALLIS: It's a better nodalization, is it?

MR. NOTAFRANCESCO: Yes. There is better nodalization.

MEMBER POWERS: Mr. Chairman, I'd better recuse myself from the discussion of this MELCOR stuff. I will comment that it has not undergone an internal peer review at Sandia, and there are internal discussions about some of the results.

MR. NOTAFRANCESCO: Our study to date has shown that igniters alone are effective in controlling hydrogen buildup. There is marginal improvement if one air return fan is included. However, the down side is that it accelerates time of high-sped melt-out. We are continuing with the uncertainty study, looking at the variations of hydrogen source terms, we'll look at other sequences.

What we've looked at so far is a fast station blackout. We're going to look at a slow station blackout looking at burn propagation numbers.

Okay. I could go with the MELCOR, but since we were inspired by Ken Bergeron's letter, we have a quick response on that, if you would like to listen. Ken is a proponent of including the fans, and we looked at his basis, and he does push the envelope on what-ifs. And he uses limiting conditions and some of it seems extreme.

The ease in which DDT is discussed is not --

MEMBER ROSEN: Would you tell me what DDT is in this context?

MR. NOTAFRANCESCO: DDT?

MEMBER ROSEN: Yes, that's a pesticide, isn't it?

(Laughter.)

MR. NOTAFRANCESCO: It's deflagration to detonation transition.

MEMBER POWERS: Let me ask a question for my own interest. I've lost track of this field. What is the quality of our predictive capabilities of deflagration to detonation transitions?

MR. NOTAFRANCESCO: Well --

MEMBER POWERS: Isn't it true that we can't predict them at all?

MR. NOTAFRANCESCO: Well, part of it we're trying to predict the hydrogen concentrations and see what the menu is to make sure if there is a chance of DDTs.

Asimios, are you going to add something to this? He's a hydrogen expert.

MR. MALLIAKOS: This is Asimios Malliakos from the staff, Research. The question, what is our knowledge to be able to predict detonation from deflagration? The first thing -- I'm thinking and talking at the same time -- we need to have a very good understanding about the hydrogen distribution in the containment. We have performed quite a few experiments. We have developed some models for the deflagration to detonation transition.

I'm not really sure what we have done in the case of ice condensers. We need to have mixers at least above nine, 10 percent, to be able to have transition from deflagration to detonation. Only at higher temperatures we can go lower than that.

I'm not sure if I'm answering your question.

MEMBER POWERS: Well, the statement here seems to imply that someone can look at a geometry and say it is difficult to get a DDT or not, presumably based on something.

MR. MALLIAKOS: Yes.

MEMBER POWERS: There are a whole raft of experiments or some sort of a predictive --

MR. MALLIAKOS: The geometry has to do a

lot with this. For example, if we have a geometry with obstacles --

MEMBER POWERS: I will grant you that. The question is: given a specific geometry with lots of obstacles in it, can anyone reliably predict whether there will be a DDT or not?

MR. MALLIAKOS: Based on if I have the hydrogen concentration? There are some areas that are kind of questionable.

MEMBER POWERS: We'll assume that you got up into the detonable range of hydrogen concentrations.

MR. MALLIAKOS: Yes. We do have models that with some reasonable assurance we can predict if it's going to happen or not, yes.

MEMBER POWERS: I'd like to see those.

MR. MALLIAKOS: Okay.

MEMBER WALLIS: There's something wrong with your bullet, though. It's not the job to show that there's ease of DDT. It's a job to show that with good confidence DDT will not occur. Isn't that what you're supposed to show? Not that it's easy to occur.

MR. NOTAFRANCESCO: Well, I was just commenting on the -- on the --

MEMBER WALLIS: Yes, but there's a different objective altogether. Trying to rule something out is very different from trying to show that it might happen.

MR. NOTAFRANCESCO: I'm not going to rule it out based on this letter. I'm just saying the tone of it, I was trying to look at its basis.

MEMBER WALLIS: No. But he is claiming that you could have DDT. He doesn't have to show it's easy to -- for it to happen.

MR. NOTAFRANCESCO: Well, he's setting up sequences or scenarios in which we're going to get this 20 percent plus pocket throughout the whole ice condenser, and it would light off, and we would have a massive explosion. And I was trying to -- I was more pointed towards his postulation.

MEMBER WALLIS: Well, can you exclude it? Can you show that what he postulates is unlikely?

MR. NOTAFRANCESCO: Well, that's why we're continuing with this MELCOR work.

MEMBER WALLIS: Oh, you're continuing to work on it.

MR. NOTAFRANCESCO: We're continuing to work on it.

MEMBER WALLIS: Okay.

MEMBER POWERS: Dr. Wallis, again, I'm -- I confess ignorance in some areas. But in your considerable expertise in using control volume codes without momentum equations to predict hydrogen distributions, is that a well-developed field now?

MEMBER WALLIS: I don't know enough to say whether it's a well-developed field. It's difficult enough to predict without worrying about hydrogen concentrations what will happen in the containment in all the spaces.

MEMBER KRESS: I think you still have the problem of --

MEMBER WALLIS: Especially with condensation.

MEMBER KRESS: You still have the problem of numerical diffusion, and you have the problem of they don't treat the momentum effects very well with the control volumes.

But the question I had earlier was, given the MELCOR calculations, I'd like to see the results of hydrogen concentration versus time and the various control volumes that actually MELCOR predicts, regardless of whether it can predict those or not. Do you have that somewhere on a slide or --

MR. NOTAFRANCESCO: Yes, I'm building to

it.

MEMBER KRESS: Oh, I'm sorry.

MR. NOTAFRANCESCO: But I'll pass this one up.

MEMBER KRESS: Okay.

MEMBER WALLIS: You have the steam concentrations, too?

MR. NOTAFRANCESCO: Yes.

MEMBER KRESS: And they're pretty low in --

MEMBER WALLIS: I don't think that was in our handout, was it, all the detail, all the stuff that came --

MR. NOTAFRANCESCO: Well, it was one of the attachments, but I -- I was given an hour and so many minutes. I have them as backup.

MR. TINKLER: Al, can I take a couple of your minutes? I wanted to respond to the questions about DDT. My name is Charles Tinkler from the Research staff.

Actually, there's been a great of work that's gone on, much of it centered in Germany and in Russia over the last 10 years to look at criteria for the transition to detonation. These are criteria for judging the potential for transition that focus on what is seen to be an intrinsic measure of the detonability of a mixture, the cell size of a mixture, which is mainly based on properties and characteristic dimensions of the geometry which confine the mixture.

Work done by the Russian Academy of Sciences, and in conjunction with work done at FCI, have developed correlations expressing the necessary ratio of characteristic dimensions to the cell size, correlations such as seven lambda and 13 lambda which give an indication of the measure of the likelihood that a mixture can undergo a detonation.

This doesn't speak to all irregular geometries, which can create local pockets of turbulence. But the state of the art for assessing detonability of mixtures is improved, and for certain kinds of geometries we think that those kinds of rough measures can give a picture of the detonability.

And I would also point out, too, that it is also -- the direction that you are concerned about, if you are concerned about circumferential propagation versus axial propagation in the ice bed, those are clearly things that we can make decisions on.

That's not to say that we have a rigorous first principles model for predicting transition to detonation. In that regard, it's clear that our ability to predict all of the contributors to irregular flow and transition do not exist. But methods have been developed, principally by FCK, for assessing detonability of mixtures.

So to simply -- and this is the point that we -- that the staff was making. To simply assert that because a mixture is richer in a region for some potential -- for some period of time, and that richer mixture presumably or a priori leads to a detonation, it simply isn't appropriate.

MEMBER POWERS: Let me come back to the correlation approach. The challenge one always faces with correlations is when you extrapolate them beyond the available database, this database that has been developed in Germany has no ice condensers is rich in ice condenser geometries?

MR. TINKLER: No. But much of the Russian data is quite large scale. And the issue of scale of experimental facilities for flame acceleration and transition to detonation is an important consideration. And the Russian data did fill a much-needed large-scale portion to the database and typically shows that mixture concentrations need to be quite high before there's a serious --

MEMBER POWERS: Well, I think that's --

before you're getting into any significant detonation, you're going to have to have a pretty rough mixture. There's no question about that.

I was struck by the numbers that you just threw out, the 11 lambda and seven lambda, because it was almost identical to the numbers for propagating from a large to -- from a small to a large channel.

MR. TINKLER: Yes, they are.

MEMBER POWERS: And that's remarkable because the physics there and the physics of the DDT are completely different.

MR. TINKLER: Well --

MEMBER POWERS: It shows you a certain universality, I suppose.

MEMBER WALLIS: Well, the bigger question is, isn't it -- it's what kind of hydrogen concentration is likely to occur with or without fans. Isn't that the issue that we're trying to address here?

MR. NOTAFRANCESCO: And that's what we're investigating.

MEMBER WALLIS: Are you going to show us that evidence, or are we going to have to go to lunch? Is there some evidence that's convincing that you don't need fans that you can show us?

MR. NOTAFRANCESCO: Well --

VICE CHAIRMAN BONACA: What concerns me, however, is that if fans -- if you show that fans are needed, then the backfit analysis says it cannot be justified. It seems to me that we are -- I don't know, we are selecting a solution and trying to justify it technically, because it's the only one we can afford. It's as if -- you know, if the only thing we can afford is a match.

MEMBER KRESS: Yes. But I think that judgment is made in the absence of a detonation in the ice chamber. If the fans could prevent a detonation in the ice chamber, then you would have a different cost-benefit ratio, I think.

That's one reason I wanted to see these concentrations and hear this discussion on why they think the potential -- or the detonation in the chamber itself is not very high. And I wanted to see the basis for that, and it has to do with the geometry of the chamber, plus the concentrations of hydrogen in there as a function of time.

CHAIRMAN APOSTOLAKIS: So detonation was not considered?

MEMBER KRESS: Not in the ice chamber.

MEMBER WALLIS: I don't understand why

there's hydrogen in there at all. I mean, you've got an early accident, and there's a LOCA, and the steam rushes in and it drags in oxygen and nitrogen. It fills up with oxygen and nitrogen. Well, how does hydrogen get in there?

MEMBER KRESS: You make it out of the clad.

MEMBER WALLIS: How does it get into the ice condenser?

MEMBER KRESS: Well, the steam condenses.

MEMBER WALLIS: The steam is already condensed --

MEMBER KRESS: The steam --

MEMBER WALLIS: -- and dragged in a lot of non-condensables which are not combustible. So it's a long story. It's not a trivial thing.

MEMBER KRESS: Well, you always have an hour in there. The hour is --

MEMBER WALLIS: You see what I'm saying. In the early stages of the accident, you don't have hydrogen. You're going to fill the ice condenser up with a lot of non-hydrogen masses.

MEMBER KRESS: Well, you're making a speculation. MELCOR calculates that for you.

MEMBER WALLIS: I hope it does.

MEMBER KRESS: And that's what I want to see. What does MELCOR tell us about that very thing?

MR. NOTAFRANCESCO: I'll give you a couple of samples of --

MEMBER KRESS: Okay.

MR. NOTAFRANCESCO: -- what we've done here.

MEMBER RANSOM: Well, the worrisome thing along that line, according to the document 1150, it doesn't account for the degradation of condensation in the ice condenser due to the presence of non-condensables.

MEMBER KRESS: Yes, it does -- it's in there. I don't know where that comes from.

MEMBER RANSOM: Well, it's in 1150.

MEMBER KRESS: Oh. Well --

MEMBER POWERS: Well, 1150 is -- the only MELCOR calculations that were done for 1150 are a pretty clear version of MELCOR.

MEMBER RANSOM: There is a discussion on the heat transfer modeling in there. It may be that that's not accurate.

MEMBER POWERS: Yes. You're talking about 12-year vintage modeling.

MEMBER SIEBER: I guess an associated

question is, if you don't have fans, and you do have core damage that results in hydrogen, it also results in direct containment heating. And without fans, you aren't melting the ice.

MEMBER WALLIS: Can we go on with this now? Weren't there different ones maybe with different nodalization in the ice condenser? Or am I mistaken?

MR. NOTAFRANCESCO: Yes. In the report there is a sensitivity, but we so far gravitated to the 26-cell configuration.

MEMBER WALLIS: Okay. But there were tests -- there were ones made with --

MR. NOTAFRANCESCO: Yes. Less --

MEMBER WALLIS: -- more nodes than --

MR. NOTAFRANCESCO: Right, 38, something like that, and 15.

MEMBER WALLIS: But they were particularly in the condenser itself, I think.

MR. NOTAFRANCESCO: Right.

MEMBER WALLIS: I'm trying to remember, because I don't have this in front of me.

MR. NOTAFRANCESCO: Yes. The condenser was divided in four axial nodes.

MEMBER WALLIS: For this one.

MR. NOTAFRANCESCO: Right.

MEMBER WALLIS: Okay.

MR. NOTAFRANCESCO: The quick overview of what we've seen so far is that if I have fans, I have more oxygen.

MEMBER WALLIS: Where are the fans?

MR. NOTAFRANCESCO: It's an air return fan. It'll take air from above and force it down into the lower compartment. It's not here. So the idea is to -- it's replenishing the oxygen. Therefore, there's more burning in the lower compartment than without the fans, in which there -- and let me go through some of this and I'll --

MEMBER WALLIS: So you burn up the hydrogen before it can get to the ice condenser. Is that the idea?

MR. NOTAFRANCESCO: Well, that's what the fans do. But there's a distribution I'll show you.

I just wanted to give a sense of the fast SBO timing, because it's nice to know what drives this is what goes -- comes from the reactor vessel. So I just wanted to highlight a couple of areas.

This case is for Sequoyah. It has pump seal leakage, and hot leg fails at four hours. And I'll show you some of the -- this is the hydrogen source for the sequence. You can see core-in covers here, and you've got a couple of --

MEMBER WALLIS: Hydrogen is already being made when the hot leg fails?

MR. NOTAFRANCESCO: The hydrogen -- right.

MEMBER WALLIS: Okay. That makes a big difference, then. I'm sorry. I thought the hot leg was going to fail first.

MEMBER KRESS: And total hydrogen produced is about 500 kilograms there.

MEMBER WALLIS: A bit squirt of hydrogen comes out, then. Okay.

MR. NOTAFRANCESCO: For completeness, let me show you the profile for liquid water, since we have pump seals, the rates on this side, S rates.

MEMBER WALLIS: So there is steam that comes out earlier --

MR. NOTAFRANCESCO: Yes.

MEMBER WALLIS: -- from the ports.

MR. NOTAFRANCESCO: The ports and the hot water coming through the pump seals, and the hot leg breaks here. I think the seals fail about two hours --

MEMBER WALLIS: So there's a lot of steam in the containment for a long time before the hot leg fails. And it's being condensed in the ice condenser.

MR. NOTAFRANCESCO: Right. So you're affecting the ice bed geometry. The melting is going on already. And here's the -- that's the steam source rate, and it really pops out at the hot leg break. So the interest is between three and a half hours, four hours.

Before I show some curves, let me show you what the -- gets some of the difference here of a table of where the hydrogen is lit off. With the igniters only, there is less -- lower containment burns. You see with fans there's more -- it's more burn.

There is burning in the ice bed because there is upward and downward propagation, and that has happened a lot earlier. Then, you get a DDT issue.

MEMBER WALLIS: So it's burning there. It's not exploding. Is that the idea?

MR. NOTAFRANCESCO: Well, they are assumed to have deflagration-type burning, volumetric burning.

MEMBER WALLIS: This ice bed is dripping? All the -- there's water dripping from all these ice trays?

MR. NOTAFRANCESCO: Well, it's going to drip into the lower containments.

MEMBER WALLIS: Can you predict deflagration and detonation in an ice bed with dripping -- full of droplets?

MR. NOTAFRANCESCO: Well, I don't -- I don't know if we can --

MEMBER WALLIS: Well, I think it would make quite a difference.

MR. TINKLER: We can predict deflagration behavior in simulated spray flow where we have droplet distributions that go from quite large to quite small, as well as in -- near supersaturated steam conditions, too. But that environment is a real -- acts to dampen the acceleration of combustion.

MEMBER WALLIS: Yes.

MR. TINKLER: That is a huge heat sink that works to slow down all combustion processes. That often is not fully appreciated.

MEMBER WALLIS: Well, I'm trying to appreciate it. What is --

MR. TINKLER: Well, I'm not suggesting that the committee doesn't appreciate it, but --

MEMBER WALLIS: What's the effect on detonation?

MEMBER KRESS: It doesn't have any effect on detonation.

MEMBER WALLIS: No effect on detonation?

MEMBER KRESS: No, because it takes place so fast that the heat sink doesn't matter. It's the geometry that --

MEMBER WALLIS: It might prevent it burning?

MEMBER KRESS: It might prevent an ignition, but --

MEMBER WALLIS: It wouldn't prevent a detonation. It might --

MEMBER KRESS: If you once started a detonation, it wouldn't have any effect.

MEMBER WALLIS: So the droplets might be bad because they prevented burning, and then we'd wait and wait and wait until it --

MEMBER KRESS: Until they build up in concentration. I still want to see the concentrations versus time.

MR. TINKLER: I think we would contend, though, that that environment would impact the likelihood that you could accelerate flame propagation and combustion, because it -- because of -- because the suspended water droplets will try to remove heat as that flame is -- as the flame propagates.

MEMBER KRESS: If you had suspended water droplets, but I doubt if you have any suspended droplets in there much. That kind of rundown --

MR. TINKLER: I think that looks like a rain forest in there.

MEMBER KRESS: Well --

MR. NOTAFRANCESCO: Let me offer you some -- I couldn't get a color one, but I'll -- it's not very simple to distinguish. This top here is steam, that's oxygen, and this is hydrogen. This is for the low containment in a particular compartment, nine. And this is the action area where the hydrogen is burning.

MEMBER KRESS: Okay. Now, do you have the same curve for a couple of the nodes in the ice chamber itself?

MR. NOTAFRANCESCO: Right. I'm going to get to that.

MEMBER WALLIS: What is the no dimension scale? That's very peculiar. It must mean something.

MR. NOTAFRANCESCO: It's mole fraction. That's all for --

MEMBER WALLIS: Okay.

MR. NOTAFRANCESCO: While I'm at it, this is the upper containment, and you can see it's about four percent. Okay.

MEMBER WALLIS: Someone is going to ask you about the uncertainty in these predictions.

MR. NOTAFRANCESCO: Okay. The ice bed is over here. If you want to see --

MEMBER WALLIS: That's mole fraction of what?

MEMBER KRESS: Mole fraction of hydrogen.

MR. NOTAFRANCESCO: Here's hydrogen. Again, the peak is steam, and the hydrogen is the lower one, about here.

MEMBER KRESS: But for a period of about four hours, it looks like the hydrogen concentration in there with the power to igniters only is about 20 percent mole fraction. Is that -- am I interpreting that right? One of those nodes?

MEMBER WALLIS: Which one is the hydrogen? It's not clear to me which --

MEMBER KRESS: I was looking at that .2 line going across. That one. That's hydrogen in one of the nodes?

MR. NOTAFRANCESCO: That's steam. The higher peak is the steam. Right here is the hydrogen. It's under --

MEMBER WALLIS: Which one is -- which curve is the hydrogen?

MR. NOTAFRANCESCO: Right where I've got the laser.

MEMBER WALLIS: In the beginning.

MEMBER ROSEN: Why don't you trace it from the beginning.

MR. NOTAFRANCESCO: Right here. Hydrogen.

MEMBER WALLIS: Oh, okay. It'll be low. Okay.

MR. NOTAFRANCESCO: Then it's here. There's a little blip because we got that big pulse, and then it goes back down. And it's --

MEMBER KRESS: And is that it continuing on after --

MR. NOTAFRANCESCO: Yes, this is --

MEMBER WALLIS: It's the fat line, isn't it? It's hard to see. So there's a time when it's up in the high teens?

MR. NOTAFRANCESCO: It may peak out briefly towards the high teens.

MEMBER WALLIS: And what's the uncertainty, you think, with this prediction --

MR. NOTAFRANCESCO: That's why we're looking at the uncertainty of the --

MEMBER WALLIS: You're looking at it now?

MR. NOTAFRANCESCO: -- of the source

terms. It drives the containment analysis how good the source terms are, so we're going to look at the uncertainty of the --

MEMBER WALLIS: But you've reached a decision already on the regulatory action. And now you're looking at uncertainty in hydrogen concentration?

MR. NOTAFRANCESCO: Right. We're going to --

CHAIRMAN APOSTOLAKIS: Can we accelerate this a little bit?

MR. NOTAFRANCESCO: Well, that's all I had.

MEMBER KRESS: I think at this time on the agenda we have plans to hear from David Lockbaum. Is David here?

MR. LOCKBAUM: Good afternoon. I appreciate the opportunity to talk to you today on this subject. The reason I came today was Ken Bergeron contacted me last week. He was planning on submitting a letter, and he was concerned that merely submitting a letter might -- you guys get a lot of paperwork, and he was afraid it would just fall on a pile.

It's very obvious that it didn't just fall in a pile. It has been discussed, so I'm not going to spend a lot of time, because that the main reason for my coming here today was to call attention to Ken's issues, and they are clearly in play.

From the observations I heard of the staff's presentation this morning, there's a couple of things that I'm confused about. It's on slides 14 and 15, slide number -- pages 14 and 15 of their presentation, where they looked at -- for non-station blackout events, they assumed the igniters and the air return fans are functional. And for station blackout events they did a MELCOR study to show that igniters only are effective in controlling hydrogen burnup -- was the staff's conclusion.

That would lead one to believe that for non-station blackout events that you don't need to air return fans either. If the fans are effective, they're effective. And I assume that would then mean that the industry could make the air return fans non-safety grade or take them out altogether.

So it looks like it supports the statement on slide 15 that igniters alone are effective, and perhaps they don't need them for non-station blackout events either.

I think, more importantly, the concern

that Ken has, that I echo, is that the low-cost estimate -- low-cost option that the staff is proposing, and I don't feel is sufficiently justified, may actually be setting the operators up for a worse accident than the one they are dealing with.

Three Mile Island and Chernobyl -- at Three Mile Island, the operators in training were stressed to avoid the pressurizer going solid, and that contributed them towards a path that wasn't as successful as it might have been otherwise. At Chernobyl, the operators were dealing with a situation where they thought it was getting out of hand, so they took action to shut down the plant with positive moderator coefficient, made things worse.

This low-cost option may be the cheapest way of setting the operators up for another bad accident, and we don't need to be doing that.

Unless a stronger justification is made for not including the air return fans in the station blackout provisions, we would oppose putting in just the igniters. That just doesn't seem -- and this bit with the 55-gallon drums of diesel generator on wheels just seems to make it a little bit easier for saboteurs to attack a plant without bringing their own explosives, and that may not be a good idea for a number of reasons.

That's all I had, since the Bergeron letter is already in play. Thank you.

CHAIRMAN APOSTOLAKIS: Okay.

MEMBER KRESS: Okay. I think at this time also we have on the schedule to hear from Ms. Ann Harris.

MS. HARRIS: Thank you. Mr. Chairman, members of the committee, my name is Ann Harris. I've traveled here today by my personal resources without benefit of taxpayer support or government payroll.

I appeared before this committee in November 1995 prior to your support to the Commission for the licensing of Watts Bar's nuclear plant -- TVA's Watts Bar nuclear plant. I moved out of the evacuation zone to a nearby area. The fact that we are all here again seven years later to hear staff's offering on the Generic Safety Issue 189, and NRC's recommendation, is evidence of how things work with staff and the industry.

The ice condenser issue may be a generic issue to you. But you should be aware that it's real people's lives you're talking about. This is not a generic issue to me. It's about the nuclear reactors just down the road from where I live and where members of my family and friends live.

I hope that you are as worried about the time factor as I am. I take it as a positive sign that at least something is going to be done, even if it's going to be just talk this time. But do we need more talk?

I was in this same room seven years ago arguing that Watts Bar was not ready for prime time. That didn't do any good since most of the problems were never fixed. They were just forgiven. Will we be back talking seven years from now when TVA and staff admit that safety is still not a prime factor? I think not.

TVA will be in the nuclear weapons production business at Watts Bar and Sequoyah because staff has never seen an industry license amendment request it did not like.

At the meeting in 1995, one of the subjects I heard about was whether the hydrogen igniters would work. My transcript of that meeting shows that Committee Member Ivan Catton tried to raise questions about hydrogen igniters and whether the igniters are Watts Bar were adequate to prevent the containment from leaking from hydrogen explosions.

In fact, he was asking questions about

whether the igniters were located in the right locations in the containment, and now here you are seven years later talking about the same thing. These meetings are like seven-year locust visits; they just keep coming.

Committee members, talking just isn't good enough anymore. Your talking has put lives at stake. It appeared at that '95 meeting that Mr. Catton was truly interested in whether Watts Bar was safe enough, but he was cut off and shut up by the Chairman at that time.

What we did not know at that meeting was that the person at Watts Bar responsible for making sure the ice condenser was working correctly before startup had discovered that the screws holding the ice baskets up were defective. TVA devised a scheme to hide Curtis Overall's discovery, then get rid of him, therefore obtaining the Watts Bar license by lying to this committee and to the Commission.

After years of investigations and court proceedings, the NRC has been forced to levy a fine against TVA. TVA has had so many fines for employee abuse they shed them off like water off a duck's back. No big deal.

The most troubling fact is that

inspections of the ice baskets that Overall wanted, and was abused for, were never done. We still don't know if they will stay put if there is an accident at the plant.

I've never told anyone that I'm an engineer, but I do have common sense. From what I understand, NRC seems to be finally facing up to the fact that ice condensers won't really work, won't protect the public during an accident. Their idea to fix the problem is to get a little portable generator from Home Depot or Lowe's, put it on a pickup truck, roll it up to containment, and plug it in.

I worked in TVA's nuclear program for 16 years, 14 of them at Watts Bar. I've seen some crazy, silly, childish, and outlandish things done in the name of safety. But I believe this one could take the blue ribbon.

I keep having this cartoon run through my head of what would be going on if this generator is needed. There is a hurricane, a severe lightning storm, a terrorist attack, a flood. It's dark, no lights, no backup power. Shift supervisor has just sent someone to the little shed out back containing the Honda generator with a copy of the combination to the padlock.

People living downstream are depending upon this person to know the combination without hunting the paper it was written on. The rain is wetting the paper. His glasses are covered with water. The wind blows the paper away, and he starts back inside for another copy.

When he gets back, he unlocks the shed, rolls the generator to the containment building, plugs it in, proceeds to get it running. I think that our lives and our property values deserve a little more concern than this NRC proposal. Why are you only recommending this blue light special approach?

I feel that the people who live near these plants are getting short-changed, run over, and made expendable. The NRC recommendation seems to say the backup power doesn't have to work if the accident is caused by a flood or an earthquake or a terrorist attack. How do you think this kind of accident is going to happen? Merlin conjuring? Whoof.

Committee members, the people living in these communities are real-live people whose lives are being talked about here this morning, not just numbers and statistics. Those same people trust the NRC to protect their interest.

I wouldn't be surprised if NRC gets

pressure from industry about making changes to the ice condensers to make them actually work. I imagine that you will be pushed to pick numbers, to redo your calculations, making it impossible to solve the problem that fixes the containment.

I'm speaking as much to licensing people in the audience as well as this committee and the Research staff, to keep in mind the interest of the real people living near these plants. Think twice about trying to make industry happy with an analysis that says they don't have to fix anything.

It is good that NRC has made a start, but so many times good starts end up as dead ends. I think you should be careful about plans to fix the ice condenser plants, depending upon the goodwill and good intentions of the plant owner.

Some of the proposed changes, like the cheap portable generator idea, seem to be planning on not having the inspections that you have for other safety equipment. I don't know about other utilities, but I know TVA well enough to know that if NRC leaves it all up to them the generator won't have a motor or a receptacle for the plug.

If there's neither inspection nor enforcement, that backup system is not going to be there when it's needed. You see, the bigger danger is to have a lot of back and forth talking, leading people to think that something has been done to fix the problem. But you and I know that's not true, and therein lies the problem. Misleading is worse than doing nothing.

I would ask that you recommend to the Commission that these ice condensers be fixed to protect the public now. You should advise the staff that they should be bending over backwards to protect the public safety, not bending over to avoid trouble from the industry.

Thank you.

MEMBER KRESS: Any comments or questions from the members? Seeing none, thank you, Ms. Harris.

And I'd like to turn the microphone over to Bob Bryan. I think he has a -- he's from TVA. He has a few words to say.

MR. BRYAN: Thank you. I just wanted to comment very briefly about the cost-benefit study. For TVA, which has the Sequoyah and Watts Bar nuclear plants, our igniter system is -- requires quite a bit more power than was considered in the cost-benefit study.

Our igniters are about 600 watts apiece, which would require a generator the size of about 21 kilowatts per train. This I think is outside the range of the four and a half or five kilowatt generator that was looked at in the low-cost option. So I think we're basically looking more at one that would be an agist of what was put together for the air return fan case.

This is just a quick look at the thing -- we're currently evaluating what the cost would be for us to install such a system with the cabling and tie-in to the 1E power system.

Thank you.

VICE CHAIRMAN BONACA: Are you considering powering also the air return fans?

MR. BRYAN: No, we're not. This was just -- the 21 kilowatts would be just for the igniters. If you powered the air return fans, depending on the unit, it would probably be between 50 to 75 kilowatts, depending on the plant.

VICE CHAIRMAN BONACA: Thank you.

MEMBER KRESS: Seeing how late it is, I guess I'll ask if there are any comments from the members that they want to make at this time, or any questions.

MEMBER RANSOM: I've got a comment.

Mark I and Mark II containments are inerted. And in the material that was provided, it was indicated that this was the more or less ultimate solution. I'm wondering, I didn't hear anything this morning about inerting, you know, the Mark IIIs and the PWR ice container -- ice condenser containers.

MEMBER KRESS: They are not inerted. That's --

MEMBER RANSOM: Pardon?

MEMBER KRESS: They are not inerted.

MEMBER RANSOM: Right. But could you inert them?

MEMBER KRESS: I think that would be a much more expensive backfit.

MEMBER RANSOM: Has that been looked at?

MEMBER KRESS: I don't know if it has in the past or not.

MR. TINKLER: Following TMI, when we -- when we examined additional hydrogen control for all the plant designs, we did consider the feasibility of inerting ice condenser Mark IIIs. But they do require much more frequent access to portions of the containment.

Normal maintenance in the ice bed, and there's -- there are a lot of systems in Mark III where people are inside the plant. So limiting access so severely as a result of inerting the plants was judged to be overall detrimental to plant safety.

MEMBER RANSOM: Is that true of the Mark I and II? I mean --

MR. TINKLER: Well, the Is and IIs are small. So you can't go in the drywell of a Mark I when it's operating, if it was inerted or not inerted. The shine -- you know, the dose -- the received dose is just so large that you just couldn't stand it. So they are not -- you know, there are other reasons why you don't want to be in a -- in the drywell of a Mark I or II. But there are many portions of an ice condenser in Mark III where you can safely go into the plant.

MEMBER LEITCH: As I recall, all the hydraulic control units in a Mark III are inside containment, and they require frequent periodic maintenance it would be very difficult to do.

MEMBER KRESS: Would the staff care to make more comments before we --

MR. ADER: Tom, this is Charles Ader with the Research staff. I was just going to mention, because some of the discussion has kind of moved around on some topics. As Charlie Tinkler just said, the earlier studies on the 50.44 rule had looked at some of these things. As part of the IPE there was a look at the backup power for igniters, and at that time everybody was looking at having to power both fan coolers and igniters, and they've generally been found not to be cost beneficial.

This study, which was an expedited study, I think there was a view that you may be able to get by with the igniters. We were trying to expedite it through, so, really, the question is: does it appear to be prudent, cost beneficial, to proceed on with powering igniters with backup power?

Now, there is some ongoing work that will continue on with the staff. We think it will confirm the conclusions. But it was not a -- going back from square one and trying to revisit things that had already been determined not to be cost beneficial. So it's really that last piece of it that we've been looking at at this time.

CHAIRMAN APOSTOLAKIS: Thank you. Would someone from the staff comment on Ms. Harris' comment near the end of her presentation that -- regarding inspection of these diesels. I mean, are you going to require some sort of inspection, so that reliability will be maintained? Or it will not be a safety-related component, so what requirements are you going to impose, if any?

MR. ADER: At this point in time, the research study is looking to technical feasibility and the cost benefit. In the general process, if we conclude that it looks like we should go forward, it would be transferred to NRR, and they would look at the actual details of how it would be implemented, whether it would be --

CHAIRMAN APOSTOLAKIS: But wouldn't, though, your assumptions in the calculations depend on this? I mean, we were told earlier that the probability of installing it and starting it correctly would be .8. But it seems to me that that .8 would depend on a lot of things, part of which would be the inspections and possible tests. So I --

MEMBER ROSEN: I would second your comments, especially with regard to testing and demonstration that these things can, in fact, be done under adverse circumstances.

CHAIRMAN APOSTOLAKIS: Right. I mean, you know, the human factors is one element, but also, you know, other things are important. And regarding human factors, I mean, she has a pretty dramatic description here of what it would take to do. Is that what's going to happen? I mean, it's going to be a piece of paper or -- you know, sometimes these mundane things turn out to be very important. So that .8 probability probably needs to be scrutinized.

MEMBER ROSEN: You know, George, we have scientific words for what Ms. Harris described -- the aeroforcing context.

CHAIRMAN APOSTOLAKIS: That's right. The context, yes. It seems to me that deserves some serious consideration.

MEMBER KRESS: Well, you know at that .8 probability you are implying goes down, then this option gets closer and closer to telling the backfit analysis. So you're forcing the regulatory analysis to say this is not a viable option by forcing the reliability down.

CHAIRMAN APOSTOLAKIS: Well, then, we have to look at the other things, too. I mean, with LERF --

MEMBER ROSEN: I don't know where George is going with his comments, but I -- my comments are along the same lines. But they are that if you're going to rely on these devices, then I would need a showing that they will, in fact, work.

CHAIRMAN APOSTOLAKIS: Do what the intent is.

MEMBER ROSEN: Yes. That there's a fairly high likelihood that they will function as intended. And at the moment, it's unsatisfactory to me to have Research say, "Well, that will be determined by NRR." Part of my decisionmaking process here will be to know what the testing and inspection regimen will be.

MR. ADER: I didn't mean to leave that impression. I mean, in our analysis, we need to make a fair attempt at trying to quantify that before we transfer it over. The specific mechanism of implementation, where there would be rulemaking, plant-specific, it would be an NRR decision.

But you're correct. We should be trying to give the best analysis and most robust we could. Some of that I think had been put in number --

CHAIRMAN APOSTOLAKIS: Oh, I'm sorry. Go ahead.

MR. FELD: This is Sidney Feld with Research. One of the cost elements that we did include in our analysis was an industry operation cost, which included quarterly maintenance, surveillance, and testing of the diesel generator. And those costs were included in --

CHAIRMAN APOSTOLAKIS: That would be an

important element, it seems to me, in the presentation.

MR. FELD: -- in the analysis.

CHAIRMAN APOSTOLAKIS: Yes, yes. That would be really an important element. But the other thing that strikes me as a little odd is the absence of an uncertainty analysis. I mean, would any of these conclusions change if one included the various uncertainties that are here?

How sensitive is the conclusion that the low-cost option is cost beneficial, if I consider all of the uncertainties? And how, you know, sensitive is the other conclusion that having qualifications, and so on, is not cost beneficial? I don't know.

I mean, when these reliabilities, and so on, are so uncertain, and what's going to happen -- it seems to me that would be one of the cases where you would try to look at the uncertainties.

MR. FELD: There is -- as I said, there is some additional work going on within staff on looking at some of the uncertainties, at least of the containment hydrogen analysis.

CHAIRMAN APOSTOLAKIS: Right.

MR. FELD: The feedback I've gotten is we think that will confirm -- you know, confirm the conclusions to proceed further.

CHAIRMAN APOSTOLAKIS: But if there is still work going on, why are we here today? I thought we were going to be presented with a technical analysis that would lead to some closure? And evidently there is --

MR. MEYER: Well, within the generic issue process described in the Management Directive 6.4, we would do technical work that would provide a basis for either dismissing the generic issue or deciding that it should move forward. And I think that we believe that we've done enough work to decide that it should move forward.

What we've tried to say is that for either the low-cost or the pre-stage option for the ice condenser plants, for a wide variety of assumed initiating event frequencies, and it -- that it makes sense to go forward. For the Mark IIIs, it's less clear that it's cost beneficial from a strictly risk standpoint, even for a range of initiating frequencies.

It seems to me that going from -- assuming that the thing is efficacious at .8 to .6, it isn't going to change the decision to move forward. The one area which is really a modeling issue -- and we're looking at the modeling issues in this -- is do you need the fans or not? That's going to dominate not differences as a factor of two in blackout frequency.

So -- and so we have an initial conclusion that we don't need the fans. That it would be efficacious without the fans. And then, we clearly say -- we go -- we've got to do some more work to pin this down, but that we've done enough that it pays to move forward.

MEMBER WALLIS: How about the comment that we heard that your estimates of the power requirement were way too low for this particular plant?

MR. MEYER: Jim Meyer again. Was the question on the -- in particular, the TVA issue with the added power requirements? We recognize that the -- the reason Catawba is our -- is kind of our base case plant, we recognize that for both Sequoyah and Watts Bar, that their igniters require considerably more power. And, in fact, it's about 520 watts per igniter compared to typically 133 watts per igniter for --

MEMBER WALLIS: I think we heard 800. Didn't we hear 800? 600.

MR. MEYER: Well, my information was 520, but we're in the same range. And so we went back and considered the implications of that, both for the pre-stage and for the off-the-shelf. And the conclusions we came to is that, yes, the cost would be higher because the diesel cost would be higher, and there would be some added engineering costs that would be higher.

But the diesel costs are only a small part of the overall costs, so the conclusion was that we still felt comfortable with our numbers.

MEMBER WALLIS: Well, his conclusion was that you couldn't get away with that portable generator. You had to go to the more expensive option.

MR. MEYER: Well, there are portable generators, and, in fact, portable generators up to 50 kilowatts. So there are such things as portable generators in that range. But I agree with you, you would move more towards the pre-stage with the TVA, because of the fact that you require considerably more kilowatts to operate the igniters. But we did take that into consideration.

CHAIRMAN APOSTOLAKIS: Any other --

MEMBER POWERS: A question was posed --

CHAIRMAN APOSTOLAKIS: Okay.

MEMBER POWERS: A question was posed about whether what droplets would, in fact, be detonation propagation? And after horsing around with it a little bit, I have concluded that both Drs. Tinkler and Kress are correct. Dr. Kress said that large droplets dripping down from the ice bed would have no impact on the shock wave propagation. I think he's correct on that large droplets sparsely -- sparse numbers. The shock wave just doesn't even know they're there.

And then -- and Dr. Tinkler is correct that applying this to sub-500 micron particles just because of the momentum effect will inhibit the propagation of the --

MEMBER KRESS: Yes. And my comment was predicated on the fact I don't think you have that size droplets in there, those tiny --

MEMBER POWERS: Yes. I mean, that's when you guys are going to have to sort out -- but whichever way it is, you understand the detonation wave correctly.

MEMBER ROSEN: Geez. Between the two of you --

MEMBER WALLIS: It doesn't -- those droplets -- everything will be over by the time they're shattered, I would think.

MEMBER POWERS: You may be able to break the big ones, but you --

MEMBER WALLIS: It will shatter them into pretty small pieces.

MEMBER POWERS: You won't break the little ones. They're -- there's surface tension there.

CHAIRMAN APOSTOLAKIS: Any other issues from the staff or members of the public?

MR. GUNTER: Yes, I'd like to --

CHAIRMAN APOSTOLAKIS: Please.

MR. GUNTER: -- if I can. Paul Gunter, Nuclear Information Research Service. I thought I heard, during the presentation, that the emergency -- that these portable generators would be fueled out of the common storage tanks. And I think that that ignores the issue of common mode failure and with contaminated fuel. So I just wanted to raise that issue as something I thought I heard and needs to be addressed.

CHAIRMAN APOSTOLAKIS: Any response?

Okay. We are running behind, so let's be back at 1:40. Thank you.

(Whereupon, at 1:04 p.m., the proceedings in the foregoing matter went off the record for a lunch recess.)

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

(1:42 p.m.)

CHAIRMAN APOSTOLAKIS: The next item is the technical assessment of Generic Safety Issue 168, Environmental Qualification of Low-Voltage Instrumentation and Control Cables.

Mr. Leitch is the cognizant member. Graham?

MEMBER LEITCH: As the Chairman has said, this is GSI-168 concerning the environmental qualification of low-voltage I&C cables. As we all recognize, these cables are very important in plant operation, since they can, if they fail, give misleading and confusing information to the operator.

We have some samples of cables that most the ACRS have seen previously, and they are identified to the tests, and so forth. These represent nothing that we have not already seen, except that some of the members of the ACRS are new since the last presentation, and they may be interested in seeing the samples. So we're not planning to pass them around, but they are here if you'd like to take a look at them. And they are all identified as to what they are.

CHAIRMAN APOSTOLAKIS: These are artificially aged?

MR. AGGARWAL: Yes, sir. That is correct.

CHAIRMAN APOSTOLAKIS: It is correct.

MEMBER ROSEN: Have they been through a real LOCA?

(Laughter.)

MEMBER LEITCH: So at this time, then, I'd like to turn the presentation over to Mike Mayfield, who will introduce his presenters.

MR. MAYFIELD: Thank you. We are here this afternoon to talk to you about the technical assessment that we have completed and the transition from research/technical assessment to NRR's implementation phase. We have a panel of speakers this afternoon that will be headed by Nilesh Chokshi. Satish Aggarwal will be -- make the bulk of the technical presentation. Paul Shemanski will have a piece of this, and Art Buslik, who did the risk assessment.

So with that, Nilesh?

MR. CHOKSHI: Okay. I think this is, given the timeframe, we have got a pretty fairly high-level presentation. We came about a year and a half ago and talked about the results of the tests and research. So the purpose -- main purpose is now that the technical assessment is complete to summarize the technical assessment and discuss the -- our recommendation.

Paul, would you put that -- okay.

CHAIRMAN APOSTOLAKIS: Can you move it higher a little bit? All the way up there.

MR. CHOKSHI: Okay. As Mr. Mayfield mentioned, under the Management Directive 6.4, the operator research completes its technical assessment. The next step is it goes to the program office for consideration for the regulatory -- for the regulatory action.

A year and a half ago we talked about the test results. Since then, we have had some interactions with industry groups, and we have done a little bit more in the risk area. So I think at this point now the technical assessment is complete.

So the primary purpose today is to give you the results -- oral results of the technical assessment recommendation, and then get your comments, and, as the process requires, we will incorporate your comments before we transmit the final technical assessment to the NRR.

Our current plan is to --

MEMBER LEITCH: Let me just say that originally there were 43 issues identified. And as I understand what happens, many of these issues were resolved from researching the literature. A number of them were felt not to require additional research. And that finally boiled down to a set of six issues that required additional research.

What we have today in the technical assessment is basically a report on the results of the research associated with those six issues. Is that a correct characterization?

MR. CHOKSHI: Yes, six. Right, there are six issues.

MEMBER LEITCH: Okay, good. Thank you.

MR. CHOKSHI: Those are the remaining ones.

MR. AGGARWAL: That is correct. However, when we interacted with the industry, as a byproduct of our research, several questions came. These were put to the industry, and we do intend to present to you the outcome of the discussions with industry as well.

MEMBER LEITCH: Okay. Thank you.

MR. CHOKSHI: So, yes, the two days -- we will talk about those six issues and seven questions, primarily findings from those.

So Mr. Aggarwal is going to do that now, give you an overview of the technical assessment. And in the end, I'll come back and talk about our final recommendation to move forward to -- this task to NRR.

So with that, Satish?

MR. AGGARWAL: Thank you.

As pointed out to you, Mr. Chairman, we met with you in October year 2000, and we presented the test results of all six LOCA tests, condition monitoring and assessment, and also we told you about the EQ literature review, the basic result being that we didn't want to reinvent the wheel. We wanted to see what industry had done so far and where we stood.

As pointed out by Graham, ultimately we narrowed it down to those six issues, and six LOCA tests had nothing to do -- there's no relationship one to one. But six tests were conducted and completed.

Subsequently, after meeting with you, we had numerous meetings with the nuclear industry and relayed many questions during those discussions, which I briefly will discuss.

One point I would like to point out, the criteria for qualification is based on zero failure, since we are only testing one single prototype. But please bear with me, and keep in mind a single prototype and the criteria is no failures.

Next.

And essentially, when you go for LOCA test, it is required that we bring that cable to the end of life condition. You had the 40 years or 50 years, and that is meaning thereby that we get thermal and radiation heating to bring the cables to that condition.

Then, we put the cable to a LOCA test sample, where either single peak or two peak. As required, in the original qualification, we go through the test procedure.

And, finally, we perform a post-LOCA test to demonstrate adequate margin by requiring the mechanical durability.

The underlying principle being that if you are part of the test, we feel that cables are so robust that we end up giving design basis even, those cables will perform their safety function.

Next.

MEMBER LEITCH: Now, the pre-aging is done by raising the temperature in accordance with the -- an iraneous relationship?

MR. AGGARWAL: That is correct. But the

staff did not come out with any numbers. What we did was these cables were previously qualified by the manufacturers, and they have taken an iraneous equation, their design temperature. They came out with a number in terms of the hours and what degree of temperature and radiation. What we did in our test, we simply reproduced those numbers.

MEMBER LEITCH: Now, your technical assessment seems to suggest or flat out states that the iraneous methodology is conservative, yet Dr. Rosen was at a fire meeting -- and we have his report -- where it seems to suggest that the iraneous relation is non-conservative. Would you discuss that?

MR. AGGARWAL: Sure.

MEMBER ROSEN: This was the wire safety aging conference held here in Rockville several weeks ago that my trip report was about.

MR. AGGARWAL: I submit that both statements are correct. Let me bring to you --

(Laughter.)

That is the diplomatic response.

MEMBER ROSEN: I think he's qualified to be on the ACRS.

(Laughter.)

MR. AGGARWAL: There is no question in my mind and the industry that there are uncertainties in an iraneous equation. It has limitations, but this is the best we have.

CHAIRMAN APOSTOLAKIS: Well, I don't understand what it means that the equation is conservative. I mean, the equation has parameters. Wouldn't it depend on the values of the parameters, or whether --

MEMBER ROSEN: Let me see if I can reproduce what the issue was.

CHAIRMAN APOSTOLAKIS: Okay.

MEMBER ROSEN: From memory, because I didn't bring my report.

CHAIRMAN APOSTOLAKIS: Did you write it?

MEMBER ROSEN: Yes, I wrote it.

(Laughter.)

The aging -- according to the people in this conference -- is a phenomena that relies on oxygen -- that is caused by oxygen diffusing into the cable insulation. And when you do a test at higher temperature to simulate long life, you are exchanging temperature for time in the iraneous equation.

You do that -- you do it quickly, and the diffusion of oxygen into the cable insulation doesn't occur, because it's a time-limited phenomena. It takes time for the oxygen to get into the cable jacket. And so the -- what you get out of a simulation -- an aging -- accelerated aging test is a cable that is not as damaged as one that's naturally aged where there's lot of time.

It's a lower temperature in the normal environment, but there's lot of time for the oxygen to diffuse completely into the cable insulation material. And to me, when I heard that, either I got it wrong or it didn't square with what you're saying in --

CHAIRMAN APOSTOLAKIS: Microphone, Art.

MR. BUSLIK: There are two effects. One is diffusion-limited oxidation, which is what you're talking about. And in a sense, you luck out. The reason is that very frequently, if the material -- the material would become as brittle on the surface where the oxygen has a chance to diffuse, and very -- and very frequently, if it becomes brittle on the surface, you'll get a crack there which propagates throughout the depth of the cable insulation. So that, in a sense, you luck out because it's the properties at the surface which are important.

There's another effect which has to do with the fact that sometimes you don't have one rate-determining constant, let's say, in the kinetics. You may have two. And in this case, if -- if the arrhenious low with the activation energy determined from higher temperatures and accelerated aging, this will always be non-conservative.

It's just a simple equation. You have a linear combination of two arrhenious expressions, and you'll see that if -- that the one with the -- I think with the higher activity energy -- I may get a -- will dominate at the lower temperatures or -- I think that's right, or else vice versa. I'd have to figure it out.

(Laughter.)

But at any rate, that you always get a non-conservative thing. However, it is possible to verify using -- you're referring, actually, to Ken Goen's work. And it is possible to verify using oxidation -- ultra sensitive oxidation consumption methods what the aging is at much lower temperatures, closer to the ones that actually occur in a plant.

And, in some cases, you obtained the fact that there is really no -- no change in the activation energy. In other cases, though, I think it is really just true that we don't know. But I think that the results that -- Brookhaven also came up with using a method of verifying the activation energy for the cables in certain isolated cases, and he found that there was agreement there.

That was -- it's in -- what is it? NUREG/CR-6704, Volume 1, toward the back somewhere. But it's true, in general, you may not know.

MEMBER LEITCH: Thank you, Art.

MEMBER WALLIS: But doesn't it depend on the material of the cable? There may be some cables for which what you say is true, that there's a severe --

MR. BUSLIK: Yes, but it --

MEMBER WALLIS: -- at the surface governed by arrhenious, but maybe other materials, presumably other studies, that say that it's diffusion-limited, refer to something real, for which diffusion is an important phenomenon.

MR. MAYFIELD: This is Mike Mayfield from the staff. I've had the opportunity to spend some time talking with Dr. Gilland, and there are a couple of different classes of the materials. The bulk of the materials that he has tests fall into a class where the iraneous equation gives reasonable to somewhat conservative predictions of the actual aging that he sees.

There is another class of materials, and part of the work is to define what exactly -- how do you characterize that class, where the iraneous equation doesn't seem to work very well, and --

MR. BUSLIK: But it's not related to the diffusion-limited oxidation so much, I believe, as the -- I've forgotten what he calls it -- the chemical.

MR. MAYFIELD: That's correct. And so there are these two classes of materials, and part of the work that he is continuing is to better characterize the two classes. But for most of the materials that we've been talking about and for the insulation materials that I believe we've tested in this program, the iraneous approach gives you reasonable to somewhat conservative predictions of the aging.

We have also acquired -- I think in the previous briefings we've talked about some -- the limited amount of naturally aged cable that we could acquire. There's only so much of this stuff you can get, where we have then also had the archival unaged material that we then artificially age.

And within the uncertainties of the actual doses that the naturally aged materials received, and the variation in material properties that just naturally occur with these polymers, you are hard put to tell a difference within the extent that we can make these kind of measurements.

MR. BUSLIK: And referring to the question about the diffusion-limited oxidation, I think maybe perhaps in all cases what you're concerned about is the mechanical integrity of the insulation, which is related to its brittleness. And if it becomes brittle on the surface, I think the cracks will generally propagate throughout. So I think, in general, it turns out to be okay there.

MEMBER ROSEN: I'm a little bit concerned about the scope of coverage of the testing. Does the conclusion that you are offering that it is generally conservative to do the pre-aging as we have done it, apply to the kinds of safety-related cables, all safety-related cables in plants? I know "all" is a big word. But let me say the majority or in the main it applies to the cables? How broad is -- is it conservative to do this? It now depends upon the kind of cable.

MR. AGGARWAL: In our test program, we tested three types of the cable, which the majority of the plants used to the extent of 75 percent or 77 percent. It is our submission that these are the principal cables which are used in I&C applications in nuclear powerplants in the USA.

The second part is when we brought up a program, we were looking at it. We were not looking at the validity of iraneous oxygen diffusion. The technical issue before us was that when we do the testing, according to IPEEE Standards 323 and 383, you are required to create the cable.

And under certain exemptions, the manufacturers have come up with certain numbers in terms of temperature and the duration. Our goal was to provide some kind of judgment what industry did. Was it conservative? The only way to verify for us was it took naturally aged cable from the plants, and then we compared what we have done after excellent rating, and the staff concluded that the techniques we used in qualification, they seem to be conservative.

Now, with regard to iraneous -- the activation energy, in a separate study we also concluded that what the industry had used seemed to be reasonable and acceptable.

MEMBER ROSEN: So you don't feel that Gilland's results are inconsistent with that conclusion?

MR. AGGARWAL: No, I don't.

MR. BUSLIK: Well, no. I mean, I don't

either. But you have to remember that sometimes it can be very sensitive to the material you have. For example, Gilland, in an old water reactor safety meeting paper, talked about a change in the activation energy for the ethylene propylene dyene monomer material. And I wrote him an e-mail about it, and it turns out that that was one used for seals, and it's mostly amorphous.

And even though it may be a problem there, it may very well not be a problem -- and probably the Brookhaven tests verify this -- for the ethylene propylene dyene monomer materials, which are used for insulation, which have a greater crystalline fraction.

MEMBER ROSEN: Okay. I'm not an expert on this. I just pointed out what appeared to me to be an inconsistency. And I just sat and listened.

MR. AGGARWAL: Thank you.

As we reported to you previously, there were failures of certain I&C cables in NRC tests, namely in LOCA test numbers 4, 5, and 6. Failures of single conductor bonded Okonite cables. Sampled more cables in test number 4, and eight out of 12 cables failed in LOCA test number 6 for 60 years.

We also found in our research that there is no single condition monitoring technique available which is effective to detect degradation. Probably combination of different techniques can be used, depending upon the type of insulation.

We also found that visual inspection can be useful in assessing the degradation of cable with time.

MEMBER POWERS: What do you mean? Clearly, if the degradation gets bad enough, I'd go in and I can see, "Yep, that cable is degraded." But it's a long time. I mean, it's -- it's visual inspection is not going to tell you anything about the level of degradation.

MR. AGGARWAL: You are correct. Again, as compared to doing nothing --

MEMBER POWERS: Ahh.

(Laughter.)

How about as compared to some of the instrumental techniques?

MR. AGGARWAL: We have discussed in our report and there are several which can be used -- elongation at the break is one which is universally used, but it is destructive. People use different matters -- the OIT, OITP, different techniques are available. And, again, each of them has limitations.

Our report, NUREG/CR, really provides that information, and we hope the industry will pick up and use it in a manner that will be useful to them.

MEMBER POWERS: Because what we were discussing earlier is you embrittle the surface, and then you get a crack, and that crack propagates through. So the embrittling of the surface presumably goes along at a nice arrhenious or quasi-arrhenious rate. But once it cracks, that's not going to be an arrhenious behavior.

MR. AGGARWAL: Correct.

MR. BUSLIK: But what is thought -- and, by the way, I think when they talk about visual inspections, they also pick up on the cable systems to see how flexible the cable is, and I guess whether there are --

MEMBER POWERS: Well, again, I mean, when -- if the damage has gone on far enough, yes, that works great. But by that time, you are in a severely damaged state.

MR. BUSLIK: That's true. But I think it's felt that if there's any -- practically any -- you'd have to speak to the people in industry. But if there's any flexibility left in the cable, or a certain amount, that the cable will survive a LOCA, at least at that time. And then you have to worry, I guess, about the rate of --

MR. AGGARWAL: The point I was trying to make was that licensees should know the environment and the reason cables are uprated.

MEMBER POWERS: Well, you've mentioned combined thermal and radiation doses. What kind of radiation doses are we talking about?

MR. AGGARWAL: We have taken 50 megarads total dose. And how much power?

MR. MAYFIELD: Basically, for EQ testing, we assume 50 megarads for the background radiation; that is, during the first 40 years. And then, typically, the accident dose is 150 megarads. So you get about 200 megarads would be the total integrated dose that the cable would be subjected to during a LOCA simulation test.

MEMBER POWERS: That does grievous damage to polybond chlorides.

MR. MAYFIELD: Yes. They are very susceptible to radiation, right.

MR. AGGARWAL: So the bottom line is that if you know the environments, some kind of visual inspections could be useful.

Next.

In the area of risk, as you must have

noted with our -- in our report submitted to you, the state of the art incorporating cable failures into PRA is still evolving. We do not advance to all of them. But it may be noted the key assumption in PRA is that the operating environments are lower than or equal to what are presumed in the qualification test.

In other words, licensees know where the hardest parts are. That is the key assumption. And, of course, the uncertainties are in terms of the experiments, human failure rates, factors, and what not. And what we find, that if the -- if any requirements such as condition monitoring, and all of this, the benefits are zero to modest.

MR. BUSLIK: If you reduce the cable failure probabilities to zero, the benefits are modest. There are benefits. The benefits are not zero. But they're modest.

MEMBER ROSEN: When you say the state of the art of incorporating cable failures into PRA is evolving, I would wonder where. What was going on that I don't know happened?

MEMBER POWERS: Have we got a long time in this meeting?

(Laughter.)

MEMBER ROSEN: On this subject.

MEMBER POWERS: Oh, oh. Okay.

MR. BUSLIK: Well, first of all, what I did was I sort of took some data from Jacobus, which he had a certain number of failures and a certain number of tests, but it was on all different kinds of cables. And I used -- all I could do was take the fraction of failures over the total number of trials, basically, and get some sort of average probability of failure.

What you would like to be able to do is sharpen that for the particular type of cable. Also, I assume that the cables were essentially at their environmental qualification limit, because that's what was tested.

MEMBER ROSEN: Are you responding to the second bullet on this question -- on this chart? My question is: what's going on in PRA?

MR. BUSLIK: No, what are we doing now.

MEMBER ROSEN: In terms of incorporating the cable --

MR. BUSLIK: Well, we are doing something. We have a project, which instead of doing what I did will attempt to estimate, using the physics of the aging of the cables, of the cable insulation, the probability of failure of --

MEMBER ROSEN: Well, there's a research project going on that might lead to some techniques that PRA practitioners could use. I don't know of any PRA practitioners in the utility industry that are incorporating cable failure probabilities.

CHAIRMAN APOSTOLAKIS: It depends on what you -- are you talking about LOCAs here?

MR. BUSLIK: Yes, yes. These are --

CHAIRMAN APOSTOLAKIS: Okay.

MR. BUSLIK: I'm sorry. These are -- the thing that is importance as far as cable failures is the possible common mode failure in the harsh environment of a LOCA.

CHAIRMAN APOSTOLAKIS: Because when you say that the results indicate that the benefits from reducing the cable failure probability is zero to modest, you don't include fires.

MR. AGGARWAL: Fire is out of the scope.

CHAIRMAN APOSTOLAKIS: Out of -- you eliminate the --

MEMBER ROSEN: No. Hot shorts or any of that, they're not --

CHAIRMAN APOSTOLAKIS: Nothing. Nothing.

MR. AGGARWAL: That's right.

MEMBER ROSEN: What you are talking about is just aging effects, I assume.

MR. AGGARWAL: That is right.

MR. BUSLIK: In fact, Steve Gullen pointed out that the -- that aging cables may actually behave better in a fire. There are less flammable, because the volatile materials come off.

MEMBER LEITCH: Could we talk about the tables that are on pages 45 and 46 in the technical assessment report?

MR. AGGARWAL: There are two tables.

MEMBER LEITCH: There are two tables, one on 44 concerning PWRs and one on 45 concerning BWRs. We need only talk about one of them. Let's talk about the one on 44. There is a core damage frequency there. Now that core damage frequency --

MR. BUSLIK: Is the reduction in the core damage frequency, if the cable failure probabilities were brought to zero from what it would be if -- if the -- if the cables had the failure probabilities that I estimated, assuming that industry essentially did nothing to try to reduce it.

But nevertheless --

MEMBER LEITCH: How could the probability be brought to zero if --

MR. BUSLIK: Well, what I'm saying is if

you have really perfect condition monitoring, this is -- then, the failure probabilities would be zero. It's a bounding case. Obviously, no condition monitoring technique is going to be perfect.

MEMBER LEITCH: Okay. Then, you give a certain credit for voluntary industry actions.

MR. BUSLIK: Right.

MEMBER LEITCH: And that --

MR. BUSLIK: And that I just reduce the values by 30 percent. This was the -- the voluntary industry actions I said were -- they were assumed to be limited to ensuring the cable environment is within the cable's environmental qualification envelope.

But actually I assume that for both cases, with respect to temperature and dose, and to inspecting cables visually, near their connections to a component, when maintenance on that component is performed. In other words, I didn't take any credit for a systematic walkdowns where there was tactical lifting of cable -- visual and tactical observations of the cables throughout the cable run. So it wasn't very much.

MEMBER LEITCH: So the first number, though, is the present state of things?

MR. BUSLIK: It's a conservative estimate of the present state of things, I would say. For one thing, all of the cables are not at their environmental qualification limits. But I don't know what the temperature and dose rate particular cables see in a plant. We have --

MEMBER LEITCH: I guess what I'm trying to do is get a feel for, where are we now in core damage frequency, where could we be with voluntary industry actions, and where could we be with a full-blown regulatory program?

MR. BUSLIK: All right.

MEMBER LEITCH: I only see two of those three numbers here. I guess that's what I'm --

MR. BUSLIK: Well, with the full-blown regulatory program, I didn't really intend to estimate it. It's bounded by the two times 10^{-5} per year reduction in core damage frequency. I mean, I don't really know how good condition monitoring could be. I don't know how accessible the cables are, things like that.

MR. AGGARWAL: Essentially, then, Table 1 tells you what the constant state is. Table 2 is telling you some allowance -- provisions for maintenance and related activities. And this is the difference.

MR. CHOKSHI: I think the most benefit you can get out is this two times 10^{-5}. So that is the upper limit of the benefit. That is this calculation.

MEMBER LEITCH: Two times 10^{-5}?

MR. CHOKSHI: That was the reduction in the core damage assuming zero probability of failure for cables.

MR. BUSLIK: And that was taken at -- between 30 years and 60 years, essentially. And before that it was zero assessment approximation.

MEMBER LEITCH: So there is -- reducing the cable failure probability to zero, the benefits are modest.

MR. BUSLIK: I think so, especially if you look at the costs. Basically, the averted costs from -- from averted accidents. They're not that high. What is it? $200,000 for a plant without license renewal or half a billion for a plant with license renewal. But those are bounding numbers.

MEMBER LEITCH: The benefits of industry actions are, then, even smaller than modest because you're getting all the way to zero.

MR. BUSLIK: That's right.

MR. AGGARWAL: Thank you. As I started earlier, that we had numerous meetings with industry.

The bottom line in the discussion with industry was that followed the claim -- the industry claim that I&C cable has not experienced any significant aging. In limited cases -- and they know of the hot spots -- the licensees are exercising several options, such as early replacement, modification of the environment, or they do some kind of condition monitoring. Whether the old plants are doing it or not, we do not know.

Aging evaluations are ongoing throughout the plant life as a part of normal life.

Turning to the 60-year aging assessment, which was LOCA test number 6, in our test, eight out of 12 cables failed the post-LOCA test. And we have concluded that some of these cables may not have sufficient margin beyond the 40 years of the qualified life.

Again, if one can conclude the operating environments are less severe than what was assumed during the qualification, then margins can be used to extend the life.

MEMBER POWERS: Let me ask a question about that. When you test these cables, you take a cable and you age it, and then you run a test on it, and that cable is a cable.

MR. AGGARWAL: Yes, sir.

MEMBER POWERS: But in the real plant, the cable that's sitting there has all kinds of junk -- dirt, all kinds of contamination stuff, and things like that. Do we know what benign junk to get on these cables and what's deleterious junk to get on it? I mean, is there -- if we spill 40 weight motor oil on the cable, it doesn't make any difference; but if we spill glycerine on it, it does?

MR. AGGARWAL: Unfortunately, I don't have an answer to that. I have not studied the research program.

MEMBER POWERS: I mean, it seems to me it's what is missing from all of this, when you start saying you're conservative, is that there's another variable that the plant experiences that we really don't know anything about. I mean, what are cables getting contaminated with?

MR. AGGARWAL: That is correct.

MEMBER POWERS: What are they in contact with that -- maybe it's not a contamination. Maybe a little nickel metal does bad things to the cable insulation in a synergistic effect or something like that.

MR. MAYFIELD: This is Mike Mayfield from the staff. Keep in mind that most, if not all, of the cables have a protective jacket over the outside of the insulation.

MEMBER POWERS: That's true.

MR. MAYFIELD: And the jacket is what would see the spill, as opposed to the insulation itself.

MEMBER POWERS: You are right on that. Of course, the jacket itself may be the -- long-term incompatibility.

MR. MAYFIELD: It's a good question, and I don't have an answer for it. It's just that there is this other barrier between the insulation that we were concerned about --

MEMBER POWERS: No, you're right on that. You're right about that. But before I jumped and said I was conservative, I'd like to know a little more about that.

MR. MAYFIELD: Didn't say we were conservative. I simply said to keep in mind there's this other layer.

MEMBER POWERS: Yes.

MEMBER ROSEN: I'm less concerned, Dana, about spilling glycerine or motor oil on them than I am about such things that are much -- such things as humid or moist salt air.

MEMBER POWERS: Sure.

MEMBER ROSEN: So a lot of these are sea coast sites. How do your tests take that into account? Or isn't it necessary to do that kind of thing?

MR. AGGARWAL: The IEEE standard does not require any conservation. It simply has a LOCA test and the post-LOCA test. And if you pass it, then you're considered to have passed.

MR. CALVO: Excuse me. This is Jose Calvo from the NRR. Most of these cables are inside the containment, so I guess this portion to salt water -- it will not be seen there. So as long as you keep that salt -- with the water and the salt from the containment, you don't have to consider that part.

MR. MAYFIELD: This GSI is focused on cables in a harsh environment, which takes you inside containment by -- virtually by definition.

MR. AGGARWAL: The bottom line of the test is that knowledge of the environment for cables continues to be essential.

MEMBER POWERS: So let me understand that -- that you have told us that if you reduce the failure probability to zero, it has limited --

MR. MAYFIELD: Dana, she's asking you to

use the microphone.

MEMBER POWERS: And I wouldn't want to get on the bad side of her, because she is behind me.

(Laughter.)

You said if I reduced the probability of cable failure to zero it does not have much impact on risk. How about the inverse problem? What's the kind -- how much risk do I gain if I raise the probability of cable failures up to one? I think that's what we usually do. Isn't it, George?

MR. BUSLIK: Let's see. I didn't bring it with me, but -- well, that would be the essentially similar -- that would be the Birnbaum importance of it. And those numbers are given here, but --

MEMBER POWERS: If I had looked hard enough, I would have found them.

MR. BUSLIK: That's right. And let me see if I can find --

MEMBER POWERS: But those are the numbers that lead you to say that it's essential.

MR. BUSLIK: Yes. I mean, roughly, I would say it could -- if you just change that in the PWR it could go up by maybe a factor -- I mean, it was a 15 percent probability of failure of instrument cables. And instrument cables were important at

Surry. So it would go up by a factor of over six.

MEMBER WALLIS: We're talking about environment. You said they failed by a crack on the outside propagating through.

MR. BUSLIK: Right.

MEMBER WALLIS: This would seem to be influenced by bending of the cable --

MR. BUSLIK: Yes.

MEMBER WALLIS: -- around corners and --

MR. BUSLIK: Yes. In fact, you find that cables could be very brittle after the pre-aging -- the accelerated aging experiments. And yet they don't fail during the LOCA, because the LOCA simulation -- presumably, because they aren't moved there. And it does introduce an uncertainty because you don't really know for sure whether the cable will be subject to vibration or --

MEMBER WALLIS: No. I mean, I feel like in installing the cables they are stretched, aren't they?

MR. BUSLIK: I don't know --

MEMBER WALLIS: They couldn't be always straight.

MEMBER POWERS: Yes. But what they --

MR. MAYFIELD: This is Mike Mayfield from the staff. Let's be careful here. Cables are, of course, installed in the unaged condition. There are criteria on bend radii. There are criteria on pull forces. There are a number of things to look at exactly the issue you are raising, Mr. Wallis, that -- so there are criteria for this.

The issue is: if you had some mechanical vibration, some movement of the aged cable during the actual --

MEMBER POWERS: Well, like maybe in a main steam line break, or something like that.

MR. MAYFIELD: Could you get enough mechanical force to move the cables enough and --

MEMBER POWERS: Those kinds of questions.

MR. MAYFIELD: -- and that's an issue that we've talked about, but I don't think we have a good answer for it.

MEMBER POWERS: I mean, it -- when you mention that movement, of course, the thing that comes immediately to mind is the main steam line break, or even a steam generator tube break, because of the apparently -- the vigorous vibrations that we expect you get there. Maybe we should be looking at that.

MR. MAYFIELD: Again, that's something we've talked about a bit. But as Satish has pointed out, what we got to in this test program specific to this GSI -- well, it didn't take us there, but it's still a valid point. It's just we didn't get there, and I'm not quite sure how you'd address it in a sensible fashion.

I know that I can move the cable enough -- aged cable enough to damage it. Now, would I get that kind of movement depending on where it is inside containment during a steam line break?

MEMBER POWERS: You know, what we could do is we could take some of that money we have on heavy section steel and apply it to --

(Laughter.)

MR. MAYFIELD: But then we would miss vitally important information dealing with other critical systems.

MEMBER WALLIS: Going back to the radius of curvature and that sort of thing, these cables are installed by somebody. Someone is laying cable?

MR. MAYFIELD: Yes, sir.

MEMBER WALLIS: And I would think in handling the cable and manipulating it around corners, and so on, there is all kinds of bending that goes on, twisting, and so forth, which is not --

MR. MAYFIELD: In its unaged condition,

this stuff is remarkably flexible. At the same time, there are criteria for how they handle it.

MEMBER WALLIS: Yes. But --

MEMBER POWERS: If you watch them pull cables nowadays, it just stuns me how careful they are about this stuff.

MEMBER WALLIS: So, well, they are in nuclear plants. They certainly aren't usually around universities where --

(Laughter.)

MR. MAYFIELD: I'm going to let that one go.

MEMBER POWERS: There's nothing critical at a university either.

(Laughter.)

MEMBER WALLIS: There are professors, and they -- they could complain.

(Laughter.)

MR. AGGARWAL: I would simply point out that in IEEE standards there is the test known as the Mandril test, that you take the cable and take so many times around it, and then test under the high voltage to show whether or not there are any cracks. So, indeed, that test gives you that kind of feeling that if anything like that happens in the life, in the operating plant, at the time of construction, then, if a test passes, you will conclude that it would be capable of handling those inspections.

This cable is put all around, and this is roughly this diameter. In Mandril, it will bend around 20 times, but that's opposed to high voltage.

MEMBER LEITCH: I have a question concerning the second bullet there. Failure in NRC tests indicate that some cables did not meet qualification criteria in the margins that we set.

Now, in your technical assessment then, there's an overall conclusion on Page 57 that says, in part, that the EQ process is adequate for the EQ of low voltage cables and INC cables for the current license term of 40 years. How do those two statements square up? It seems on one hand you're saying the process is adequate, but here you've had some cable failures.

MR. AGGARWAL: My submission is that the process of qualifying cable is adequate. It presumes that the licensees know their environmental conditions and they are monitoring them. And if those conditions are lower than those during the qualification, then there is no problem. But if they do not know, of course there is a problem. This is how I will explain the failure.

MEMBER LEITCH: Now, you had some cables, I guess it was Samuel Moore cables that failed above 77 degrees at less than 40 years --

MR. AGGARWAL: Okonite cables.

MEMBER LEITCH: Okonite, was it? Yes. I'm sorry. Yes. That failed at less than 40 years service. So do we know that those -- that cables are not in the field and operating in those conditions?

MR. AGGARWAL: Okay. In a nutshell, the story about Okonite cables is that those cables originally qualified for 90 degrees C. And the manufacturer had never tested those cables in real life. He used a similar argument. Bigger cables were tested, and he applied that to the smaller cables. Now, when these cables failed in an RC test, the manufacturer named the Okonite and tested the cable themselves on their own initiative. And they concluded that their cables are only good for 77 degrees.

Now, NEI has done a survey and they indicated that probably four plants might have that problem but definitely one of them exceeded those conditions. And I do not know the name of the plant, and I do not know, you know, what the conditions are.

We do know that there is one plant which apparently has exceeded --

MR. CALVO: Excuse me. Let me augment this a little bit. Yes, we don't know whether one plant, we don't care to a certain degree, because the important part is that a new test has been done that demonstrates qualifications -- establish a new qualification threshold, which is at a lower temperature. One plant is very close to that, and you can say that where that plant may not reach the annual life of 40 years, but that's part of the Environmental Qualification Program. It's a lot of stuff out there that hasn't reached 40 years, and the Program requires that you replace them or you do some testing or you do some analysis.

So knowing the plant is not important. What is important is that the Okonite has informed all the licensees that report that kind of cable and told them, "This is a new threshold." Now, you look there pursuant to 10 CFR 50.49 was the EQ rule that's supposed to do whatever corrective action is necessary. And all that thing has been taken care of.

Now, the Okonite failure was not a safety significant failure, it was a very limited, very limited application on these cables. It was mostly a single conductor and it was very, very few of them, okay? So that one is not on the control. The licensees are being advised that corrective actions have been taken, pursuant to 10 CFR 50.49, so, presumably, that part is done.

MEMBER LEITCH: So that's what gives you the confidence then to say that the EQ process is okay? In other words, if the process is correctly followed --

MR. CALVO: Right.

MEMBER LEITCH: -- then -- so the 77 degrees is fed back to the licensee and he does all the right things and his plant environmental conditions are known and he factors that into the process, the process is okay.

MR. CALVO: Right.

MR. AGGARWAL: That's correct. And the bottom line, as you see, the knowledge off the operating environment is essential. The licensee, he should know where the hardest parts are.

MEMBER LEITCH: But the process is okay for 40 years.

MR. AGGARWAL: Correct.

MEMBER LEITCH: And what about for 60 years, is the process still okay, if he's still has all those things?

MR. AGGARWAL: Processes are still good as long as you know your environment.

MR. CALVO: If I may, the process is the same process. All you do when you reach in 40 years the question is being asked does this cable have sufficient life to go 20 more years? And what you do is you look at all the information that you collected over the previous years and you determine that the actual service conditions are sometimes much lower than the actual temperatures or radiation that this particular cable will qualify. So based on that, most of the cable that we see in the license renewal has been reanalyzed and concluded that because of the lower actual service conditions, you can extend it for 20 more years. So the process is the same process. It's a program that is still -- it's assumed that the cable -- the life is 40 years. You've got to make a decision to go beyond 40 years. Either replace the cable or you want to license it and you determine -- or test it or you determine what you're going to do with it. So the rule has those provisions built into it.

MEMBER LEITCH: So I think a lot of what our -- well, at least what my questions comes down to is not so much the research report but what is NRR going to do to implement that? And I guess we don't really have -- I mean this hasn't really been presented to NRR yet or it's just now being presented.

MR. CALVO: We've been working with research in these efforts, and we have reported the results. I guess the knowledge of the environment I think is necessary to ensure that the balance of the equipment within the qualified basis of the particular equipment. I think what is important knowing the environment is that's still to predict failures, but it should -- it verifies the fact that the equipment is within the tested parameters. It tells me that the equipment was qualified for these parameters, continues to be qualified. If it is not qualified, then the rule will come in, the process will tell you that you've got to do something about it. Something can very well be that it wasn't good for 40 years, maybe only good for 38 or 35. A decision has to be made when you reach that point there.

We know that knowing the environment it is important. It is necessary to establish that your equipment continues to be qualified. We know that they have done it, we know that we have done some inspections several years ago to verify some of that.

Then about three years ago we have done recently a programmatic evaluation of the program itself with some licensees. We verified that the program was adequately implemented as part of the license renewal. We're also doing some verifications right now to see that we can extend it for another 20 years. So we know the environment has been done. We see no smoking guns, that it will probably be the NRC or NRR to go there and do inspections at this time. We feel that they have done the correct thing up to now.

MEMBER LEITCH: So this will ultimately depend on voluntary industry actions rather than a big regulatory --

MR. CALVO: Well, no. It's an environment -- they've got to know what it is, because, you see, the rules say that equipment must be qualified and remain qualified for the life expectancy. So if the environment that you predicted changes, that means the qualification also has to change. So this is -- if they're meeting the rules, which I know they're meeting the rules, they've got to do these kind of things.

So they force them to do it. Just like any regulation, they've got to do it, because it's the only way that you ensure you do some maintenance, you replace something, you put a barrier there or you do some operating things in there, some events. The program requires them to evaluate to determine whether the qualified life remains what it was 20 years ago when the equipment was qualified.

MR. MAYFIELD: This is Mike Mayfield. Let me take you to -- Jose's provided, I think, a good summary on the technical side. The process, we'll transmit our findings and recommendations to NRR for the implementation based on our discussions with Jose and the Management. I think the anticipation is this will go into their generic communication process and, like you say, will go to some voluntary action. I think that's prejudging a bit. I'm not quite sure today what will come out of that process, but I think the expectation that they have expressed is it will go into their generic communication process and play out from there.

MEMBER LEITCH: So would the expectation be that we would hear another presentation once we know what those actions are?

MR. CALVO: It all depends how much you want to know about EQ. That will be fine. We'll be happy to do it.

MR. MAYFIELD: I think if the Committee

asked for that, then the staff would be prepared to support that request as well.

MEMBER LEITCH: I see. Fine. We're running -- we have three more minutes to go here.

MR. AGGARWAL: Okay. I'll do 30 seconds. The industry practices, as described by NEI in their letter, in the staff's opinion, seems to be educate but the plant-specific practices are not known to us. Again, as I stated earlier, walk down to look for any visible sign of degradation we find can be proven useful and effective, as compared to nothing.

MR. CHOKSHI: Okay. I think just to the summary, and already we touched on this, and I think Mr. Mayfield described, our recommendation is to the NRR, and we have been discussing this with NRR, is to look at the dissemination of this information while they generate a communication process. And I think it's important to, as itemized here, the results of the tests and potential implications so that the licensees can evaluate the results of the tests for themselves a summary of Okonite.

And I think that one of the things is all of this information the last item, the importance of the knowledge of operating environment and hot spots is really critical to address many of these issues by doing reanalysis, understanding the remaining margins, remaining life. So I really think that information needs to get out and then the communication process should determine the level of the communication or any other subsequent actions. So it is, as noted in the transmittal memo to you and in the technical assessment, we are following this to NRR with a recommendation that they use the generic communication process for dissemination of our findings. So that's the overall presentation with the technical assessment and where we stand.

MR. AGGARWAL: And, certainly, we look forward to receiving a letter from you in terms of your advice, comments which we will cooperate and finally submit to the Director of NRR.

MR. MAYFIELD: That concludes our presentation.

MEMBER POWERS: I have to say that in some sense this is the kind of research you wish NRC had more time to do, where you can go through and do a technical assessment in the field, not necessarily coming up with anything regulatory but saying, "Hey, guys, these are the things that we worry about, maybe you ought to worry about them." It's kind of a nice thing for a regulatory body to be able to do, summarize a field, show some data, show some concerns and show some ways of handling it. It's kind of nice.

MR. AGGARWAL: I wish we have unlimited funding and unlimited time.

MEMBER POWERS: Yes, yes.

MEMBER LEITCH: Any other questions?

MEMBER POWERS: Well, have you thought about mining the heavy section steel funds?

(Laughter.)

MEMBER LEITCH: Mr. Chairman? I turn it back to you, Mr. Chairman.

CHAIRMAN APOSTOLAKIS: Thank you, Mr. Leitch. Thank you, gentlemen. Appreciate you coming here. Our next -- we're supposed to continue with this. I don't like that. We'll take eight minutes and be back at 2:50.

(Whereupon, the foregoing matter went off the record at 2:41 p.m. and went back on the record at 2:51 p.m.)

CHAIRMAN APOSTOLAKIS: The next item is the development of reliability/availability, performance indicators and industry trends. The cognizant member is Dr. Bonaca, so Mario, please lead us through this maze.

VICE CHAIRMAN BONACA: Well, in order to

identify and evaluate potential new PIs, the Agency's conducting a pilot program, monitoring the unavailability and the unreliability of several risk-significant systems identified through the Phase 1 performance indicators. The pilot includes an attempt to integrate unavailability and unreliability for each set of the system, train into a risk-informed PI called Pilot Mitigating System Performance Indicators. I hope I quoted it correctly.

We received an update on this issue at the Subcommittee last Thursday. The staff is here to present this work. They have pointed out to us that this is work in progress. This is the first of several updates, two or three updates they plan to give us. At this stage, don't expect a letter from us, but this is an important update for us. I believe during this presentation the staff will also discuss performance and accountability reports determination, that no statistically significant adverse industry trends in the performance that are identified for 2001.

With that, I'll pass the presentation to Mr. Baranowsky.

MR. BARANOWSKY: Okay. Thank you, Dr. Bonaca. Let me go to the first viewgraph. As you said, the purpose of this presentation that I'm going to give, which is going to be divided into two parts, one that I'll give and one that Tom Boyce will give. The first one is on an overview of the reliability and availability performance indicator pilot program, which is being done for the reactor oversight process, as led by NRR and supported by the Office of Research. And it's an informational briefing. I've identified in this first viewgraph what the content of this discussion will be, a little bit on the background, some of the problems that we're trying to solve, some insights that we derive from studies that were done on risk-based performance indicators, a very brief discussion of the technical approach that we're taking.

We're also going to mention the issues that were raised at the Subcommittee because we want to make sure we're capturing those for when the next time we come we want to address those properly. And then we'll talk about some conclusions and the implementation schedule.

Just briefly on the background, SECY 99-007, which is sort of the base document for the reactor oversight process, did identify that the performance indicators that were proposed and promulgated as part of that paper had some limitations in them because they were put together in basically a few-months time frame, and they borrow heavily on existing performance indicators which were known to have limitations in terms of their risk-informed characteristics.

During the first couple of years, the reactor oversight process and a number of technical issues came up that have to do with how the indicators are formulated and deal with incidents in their accounting. And, as such, a working group was formulated and the Office of Research participated in this working group and suggested that some of the technical work that we had done in the performance indicator project could be used to solve many of the problems, but not necessarily everything.

So the reliability and availability performance monitoring approach that was selected for the mitigating systems can be described as but one aspect of an area of improvement in the reactor oversight process, and so we're looking to at least move forward step-wise in making some improvements there.

The problems that we are trying to address in this project are as follows: The current performance indicators, in particular for the mitigating systems, include design basis functions along with the risk-significant functions, and that sometimes provides improper importance to the design basis functions that are not risk-significant, and so there's a desire to make a correction there. The thresholds of performance used in the current performance indicators are generic, one-size-fits-all, and there have been a number of problems identified about the lack of being risk-informed in that regard because of the variation in risk from plant to plant, especially for different mitigating systems.

The demand failures were accounted for as an unavailability of sorts in the so-called fault exposure hours, and they end up, in many cases, providing an overestimate of the risk significance of what the demand failures actually result in in terms of their impact on plant risk. And there are no performance indicators currently in the ROP that are directed toward the support systems.

The unavailabilities of the support systems are currently cascaded onto the unavailabilities of the monitored system. And the concern there is that the monitored system is being, in terms of its unreliability and unavailability, is being dominated by the support systems, or at least it can be. And so we're looking for an indicator that can give us information about the monitored system in addition to the support systems.

VICE CHAIRMAN BONACA: Now, isn't there a major problem with the PIs, the fact that the thresholds that are risk-based are kind of unrealistic because one single PI has to raise the core damage frequency by a significant amount.

MR. BARANOWSKY: Yes.

VICE CHAIRMAN BONACA: And we know in real life that doesn't happen. I mean it's usually a combination of things.

MR. BARANOWSKY: Right. Actually, part of that problem has to do with the selection of the PIs, and the other part has to do with the formulation. The one in particular that you run into that problem the most with is the initiating event performance indicator where all reactor trips for all plants are treated equally. Well, if you look at the risk significance of different initiating events that involve reactor trips, you can easily see orders of magnitude difference in their risk significance.

And if you want to capture that correctly, you have to have a more risk-based formulation to reflect that such that the more risk-significant failures would have a less tolerance than the less risk-significant ones, and you wouldn't put equal weighting on them. And then you would come up with a different threshold, if you will.

And the approach that we're taking on the mitigating systems could actually be used on the initiating event systems. We might look at that in the future to correct that one. I'm not sure we run into the same thing on the mitigating systems, but that's a correct point.

So let me just cover some of the problems that we are trying -- that we think that these modified performance indicators will correct. First of all, we worked to make sure that the risk-significant safety functions are the ones that are captured in the performance measurement. Now, the performance indicators, the way they're formulated, they account for a plant-specific design and operating characteristics through the use of available risk models and data. And available risk models are basically the site-specific PRA for the licensee, and I think I'll mention later that the NRC will be doing parallel analyses using our own risk models in the form of the standardized plant analysis risk models or

SPAR models.

The demand failures are now accounted for correctly in the reliability formulation. They allow for the accumulation of failures to be more appropriately counted in the performance indicator. The performance indicators are going to now include separate indicators for the cooling water systems that provide support to the mitigating systems for which we currently have performance indicators, and that will eliminate the cascading problem and sort of an unfair count, if you will, of the indication of performance in those other frontline systems. But it will also treat the support systems according to their risk significance in the model.

The other thing I want to mention is that we believe that this pilot addresses at least some of the things that were raised by the ACRS, maybe not every single question. But the issue of the plant-specific thresholds is addressed. The technical basis for the choice of sampling intervals, we believe that was covered primarily in our risk-based performance indicator report, but we still will provide additional basis to have a complete package in this application.

And there was also an indication that the action levels should be related explicitly to risk metrics, such as CDF and LERF, and I think we have at least an improvement in that area from what we had before.

Okay. Just to quickly go over the insights from the Phase 1 study of the risk-based performance indicator report, because that was the technical foundation even though the formulations are a little different now, but that was the technical foundation for what we're proposing in these performance indicators.

We identified that there were enough risk-significant differences amongst the plants that we had to have plant-specific thresholds for both unavailability and unreliability, and the mitigating system performance indicators will handle that. The unavailability and unreliability indicators were found to provide an objective in risk-informed indication of plant performance. And by that I mean they're logically connected to risk. You can actually trace what element of risk is associated with these indicators fairly directly.

And they provide broader coverage of risk than the current indicators, which we mapped out in that report, which I believe was NUREG 17.53. We mapped out the coverage that the performance indicators gave in terms of systems equipment and accident sequences. Do I have that right? And we looked at this for an example of 44 plants, so we have a pretty good feeling that we have good coverage there.

We did find that doing performance indicators for component cooling water and service water systems were a problem. But the formulation that we're proposing now using importance measures solves the problem of having many complex models to deal with, and I think it's really a step forward that allows us to incorporate a simple formulation to represent a more complex situation.

And the last thing is we did use some data analysis using Bayesian update approaches, which, based on our statistical analysis, we were able to I'll say minimize practically the likelihood of false positive and false negative indications. What we're interested in there is if there is a performance issue that's because of statistical issues is not showing up but that could be, say, read in the current oversight process, we have a very, very, very small likelihood that we would miss that performance issue.

On the other hand, if there is not a performance issue, there is a relatively small, not quite as small, but a smaller likelihood that we're going to call it a performance issue. I mean you have to make some balances on these things. You can't get them to be all completely small. And we looked at different approaches. And in fact that's still an open issue, but it's an item that I think is the strength of looking at some of the statistics involved when you go through these formulations.

Now, the mitigating system performance index, or indicator, was formulated a little bit differently from that which we used in the risk-based performance indicator project in that we're directly looking at a change in cord damage frequency as an index. And it's an index because it's incomplete but it accounts for the elements of plant design and operation and risk that are accounted for in the current indicators, at least, as a minimum. They might account for more, but at least accounts for those. It's primarily at the Level 1 from a PRA point of view, full power.

Also, the indicator has two elements to it, the unavailability and unreliability, which during the risk-based performance indicators, when we worked with the metrics of unreliability and unavailability, defined properly, we had trouble combining them in other than a complex model, almost a full PRA. When we came up with a similar formulation, we were able to combine them in something that's at least easy to look at, even if the bases behind the weighting factors is -- well, it's a little bit complex.

And also we're baselining performance similar to the principles espoused in SECY 99-007 wherein we are trying to look at the 1997 time period as a baseline. And that's still an issue to be covered in future studies and presentations to this group as we move along.

So just to move down on this particular next chart, you see that the mitigating system performance index is an unavailability index plus an unreliability index, and one of the nice characteristics of this is it allows some balancing of unavailability and unreliability or if both are declining, then they're properly accounted for, instead of having separate indications looked at independently, as if one's frozen and looking at the other, and this matches up with the maintenance rule. So it was -- one of the major concerns that we have about the maintenance rule was accounting for unavailability and unreliability differently and then the combination of these things differently, and I think we've solved most of that here.

MEMBER ROSEN: And it's attractive to me too, because you can have a system that's perfectly available but highly unreliable because you run it all the time and you haven't maintained it, or one that's totally reliable and completely unavailable because you never run it and you're always maintaining it. But here -- and, clearly, the licensees have to make that balance. And, clearly, this indicator, because of its mathematical formulation, allows you kind of -- it portrays the balance.

MR. BARANOWSKY: And the other thing that's nice about breaking these two things out is, as we discussed at the Subcommittee, the unavailability indicator covers maintenance downtime and corrective actions, whereas the unreliability one covers whether it performs as indicated when it's tried. And that helps you focus any look, if you will, as a regulator in terms of what kind of follow-up actually it would take if, let's say, this indicator were to go over some threshold. And it's also, I think, useful for licensees to look at it that way, which they do in the maintenance rule, so it's consistent with that.

The next chart just shows a list of the systems. Basically, we have -- for boiling water reactors, we have three cooling water systems that are more or less what I would call your front line ECCS type systems: The emergency diesel generators, which are part of the emergency AC power system, and then the support system cooling, which in most cases involves systems with the name emergency service water, reactor building closed cooling water or turbine building closed cooling water systems or their equivalent. And then for the PWRs, we have injection systems represented by high-pressure injection and the RHR for low pressure considerations, the auxiliary feedwater system, again the emergency diesel generators and again the support system cooling functions with some different names.

Now, let's talk a little bit about the limitations of performance indicators, because we spent a long time, I mean months, going over what can and can't be captured by these performance indicators. The performance indicators are meant to look at an accumulation of information over a period of time, one to three years or so, and then draw some inference about performance. Individual incidents are meant to be covered by a risk assessment type indication. So what we did was we identified the types of individual --

VICE CHAIRMAN BONACA: The STP.

MR. BARANOWSKY: The SDP, for example. SDP Phase 2, Phase 3 type activity. And so what we did was we went over, well, what are the kinds of things that can and can't be reasonably captured and have good statistical characteristics for us to measure performance with? And we have this list here, like common cost failures. We know that they have a risk significance, but we can't track enough years to get common cause failure into the reliability formulation, but over time the common cause failure impact on the risk-importance measure, whether it's Fussell-Vesely or Birnbaum, will show up.

So it's counted for in time, and it's instantaneous, if you will, implications in the reactor oversight program inspection process will be captured through the SDP. And the same goes with passive failures. And there's a few systems components that are highly reliable. The system is highly risk-significant, and single failures over a period of one to three years don't have very good statistical characteristics to them, and those also would be looked at as if they were a rare event in risk space.

Okay. Now --

MEMBER ROSEN: If you're done talking about the limitations

MR. BARANOWSKY: No, I'm not done. Well, I'm done with that limitation. I'm going to talk about some of the -- we're going to look at a number of technical issues, which we don't -- we wouldn't say they're limitations but they're still open in terms of how to make a final formulation on them.

MEMBER ROSEN: Well, of all the limitations that you've mentioned, the most important one is one you really didn't call out as a limitation. And that to me is that this only covers at-power situations. Risk doesn't go on a holiday when you take a plant off the line.

MR. BARANOWSKY: Yes.

MEMBER ROSEN: And so the shutdown risk is important, even though there are people in this Agency who don't think that. It's my view that it's fairly important. And depending upon exactly what you do during shutdown, PWRs and mid-loop, for instance, create a lot of risk during that period.

MR. BARANOWSKY: Yes. I think --

MEMBER ROSEN: If you don't go to mid-loop, well, okay, maybe you don't have a risky outage. But mid-loop operation especially hot early mid-loop is a risk configuration. So I think when you're setting up an index program like this, if you're not looking at shutdown risk, you're not showing the whole scope, and that's one of the -- to me that's the principal limitation.

MR. BARANOWSKY: Okay. That's an excellent point, and we looked at that in our risk-based performance indicator study. And one of the things that we found that was a problem with the current indicators and even the current maintenance rule implementation was that the performance of equipment during shutdown was being overlaid on top of the performance of equipment during power, and the risk metric being used was the at-power risk measure, which really is erroneous.

We did a fairly good look at this and concluded that we don't have enough data during shutdown to look at reliability and unavailability in the cumulative sense that we do in these performance indicators, but that we could look at what occurred during shutdown and the different modes that occur during shutdown, including like mid-loop, as you said, and make a judgment call about the risk implications of shutdown operations that could improve the way the significance determination process, as opposed to performance indicators, can take a look at the implications of shutdown in the reactor oversight process.

So we're working with NRR now to take those insights and try and get them into the shutdown significance determination process. If we had the shutdown risk models, we could use risk metrics for unavailability and unreliability that were appropriate for shutdown, but we don't have those.

MEMBER ROSEN: I don't think I want to tell you how to do this, because I don't know, but I do know that it's a big hole and that you ought to be working towards ultimately including risk during shutdown in these programs.

MR. BARANOWSKY: We're going to have shutdown risk models for SPAR because we need it for the Accident Sequence Precursor Program. As you say, you get enough risk during shutdown that we have to be able to evaluate that. I suspect that -- and that won't take a long time. I think it's a couple of years to have pretty good models, at least in terms of what we know today about shutdown risk, maybe not some new stuff. But we should be able to look -- first, we'll have the reactor oversight process, significance determination process incorporate the insights from the risk-based performance indicator study in this area, and then, if it's appropriate after discussions perhaps with this group and others, we'll look at whether other performance indicators make any sense if we have the risk models to set the thresholds by. Otherwise I don't have a way to do it. I can't set them with the at-power models, which is really all we have available.

MEMBER ROSEN: Well, I don't think you should have -- let the excellent be the enemy of the good in this case. You should try to find something rational to do to begin to measure risk during shutdown and try to put that into the program. Maybe it's something as simple as duration in hot early mid-loop.

MR. BARANOWSKY: Yes. That's exactly right.

MEMBER ROSEN: And time runs from subcriticality, some kind of index like that.

MR. BARANOWSKY: Are you sure you didn't read our report? Okay. Why don't we cover that at the next ACRS Subcommittee meeting, because I think we did a nice job in looking at that and see if it answers your questions or if you have other issues that you think we need to look at.

MEMBER ROSEN: You say you're going to cover it when?

MR. BARANOWSKY: At the next Subcommittee meeting, which we're going to have -- proposing in November.

CHAIRMAN APOSTOLAKIS: He's proposing two more.

MEMBER ROSEN: Good.

MR. BARANOWSKY: We had so much fun at the last one.

CHAIRMAN APOSTOLAKIS: One of the few staff members who loves us.

MR. BARANOWSKY: I'll bring the doughnuts.

MEMBER ROSEN: We can do something to get him not to love us.

MR. BARANOWSKY: That would be hard. Okay. The next -- so we're going to look at a lot of things during the next several months, and we're going to report back to you on that. Let's go to the next one.

Just quickly, let me summarize here what I think were the highlights of the Subcommittee meeting that we had on May 30. You were looking for the reasons and justification for the selection of the baseline values that we had. That was an issue that was discussed quite extensively. There were questions raised about use of the thresholds that are currently in place and we derived from SECY 99-007. We're going to talk about that.

And then also there was quite a bit of discussions about the formulation that we had for the PI, including the use of Fussell-Vesely in different parameters in that equation, and we're going to put that all together in a white paper of sorts before -- if you'll allow us to have another Subcommittee meeting, we'll do it then, and you'll see in my schedule we're shooting for a November time frame.

CHAIRMAN APOSTOLAKIS: Good.

MR. BARANOWSKY: And we'll also be able to report on some of the initial implementation activities and issues that come from the pilot, presuming it gets off the ground at that point.

So to conclude, I think the maintenance of the mitigating system performance index approach is based on risk insights, and one of its strengths is that it accounts for plant-specific design and operating characteristics through the use of the available risk models and the data. Currently, we're using the Fussell-Vesely importance measure. We might look at Birnbaum and some other possibilities to see if they have better characteristics.

We're treating demand failures in an unreliability context. We're using Bayesian update to get the best statistical treatment that we can. The risk-significant safety functions are now a significant focus for the success criteria in determining what's a failure and what's not a failure that goes into the performance indicators. And we're going to be able to, we think, incorporate the cooling water systems that provide support to the more front line systems. We can balance unreliability and unavailability or if they both go up or both go down, the indicator covers that. It's a fairly objective indication because of its link to the risk model.

We've identified limitations. You've brought another one up here. We're wide open to hear more and see if we can either address them or make sure that they're accounted for in the significance determination process. And we believe that this indicator provides the right vehicle for making an appropriate risk characterization of performance that's related to reliability and availability of equipment.

So we have a schedule, as indicated here. We're going to have a workshop to go over how one can implement the formulation that's been proposed. We're going to try and start the pilot around August 1, somewhere around there. We think that around November, depending on your concurrence, we might be ready to come back, talk about some of these technical issues and how things are going. The pilot will end, the data collection and sort of online trial period, if you will, in February. We'll take about six months to assess that, but in that six-month period, we'd like to have another briefing to let you know how things are coming, because I think, ultimately, we would like to get some kind of a letter from the Committee, and that's probably around the summer of 2003.

CHAIRMAN APOSTOLAKIS: You'd like some kind of a letter or a good letter?

MR. BARANOWSKY: Some kind of good letter.

(Laughter.)

That's all I have to say.

CHAIRMAN APOSTOLAKIS: Any --

MEMBER ROSEN: You have another plant participating in the pilot --

MR. BARANOWSKY: Oh, sorry.

MEMBER ROSEN: -- slide. You don't want to put that up.

MR. BARANOWSKY: Right. Go ahead and show that if you want.

MEMBER ROSEN: Because it reminds me of the punchline in Casablanca, "Round up the usual suspects."

MR. BARANOWSKY: Some of them are there.

MEMBER ROSEN: Well, when are we going to see a list of people participating in the pilots with another name on it, other than "usual suspects?" I'd like to see some spreading a little bit.

CHAIRMAN APOSTOLAKIS: Palo Verde is there, South Texas is there.

MR. BARANOWSKY: Actually, South Texas is just -- is a relatively recent addee, because we have been working this group of pilots, and South Texas wasn't there on the first list.

MEMBER ROSEN: Yes, but it's one of the usual suspects. But I'm talking about seeing some plant that's new to the game.

MR. BARANOWSKY: Davis-Besse?

MEMBER ROSEN: Perhaps.

MR. BARANOWSKY: But I think this group will be --

MEMBER POWERS: Let me -- I'm not sure I understand the question. I look at this list and I say, hey, this is a pretty good cross-section. I got Hope Creek and Salem on one end and I got Palo Verde and that damn thing off in Texas someplace on the other end. That's a fair cross-section.

MEMBER ROSEN: Well, I'm just talking about some plant that has not participated at developing new capabilities and getting into the -- you know, I'm just railing at the idea that it's always the same plants that --

MEMBER POWERS: I mean just to have somebody participate that's for participation sake doesn't strike me as very useful.

MEMBER ROSEN: Well, it has much more to do with --

MR. BARANOWSKY: Tom Houghton from NEI would like to address that.

CHAIRMAN APOSTOLAKIS: We have a comment from the industry.

MR. HOUGHTON: Tom Houghton, NEI.

MEMBER ROSEN: Is there a law against that?

MR. HOUGHTON: Actually, comparing pilots before -- Limerick's new, they haven't participated; Millstone's not participated; Surry has not participated, Braidwood has not participated, Palo

Verde, San Onofre and South Texas have not been pilots. None of those have been pilots before, so we do have quite a different --

MEMBER ROSEN: You're talking about here in this particular program.

MR. HOUGHTON: Well, in the reactor oversight process.

MEMBER ROSEN: I'm talking about the use of risk techniques in general.

CHAIRMAN APOSTOLAKIS: He's broadening the issue.

MEMBER ROSEN: And Dana accuses me of prosteltizing, and I plead guilty. The idea being that the more people get involved in the formulation of these kinds of things, the more likely we are going to have smoother implementation, more broader implementation.

MR. BARANOWSKY: Tom, what about the --

MR. HOUGHTON: We also do have, I don't know whether it's a good name to use or not, but plants that are shadowing this process, so we will have probably I would guess an equal number of plants that are going to play along with the process but not be officially in it. So it will be quite broader.

MR. BARANOWSKY: And we expect the

workshop to have a large spectrum of participants, and probably when we have summary meeting afterward to go over issues and how they're resolved, I think not only these shadow plants but others will be involved.

Okay. So we'll, with your agreement, come back in November or there abouts.

VICE CHAIRMAN BONACA: Thank you. That was a good update. And now we have the report on no statistically significant adverse industry trends.

MR. BOYCE: Good afternoon. I'm Tom Boyce of the Inspection Program Branch of NRR, and I'll be presenting the industry trends portion of this briefing.

We're going to be covering today some of the background for the program, how we communicate with stakeholders, the process for identifying and addressing industry trends, other results for fiscal year 2001 and where we're headed in the future.

As background, one of the performance goal measures in the NRC strategic plan is that there be no statistically significant adverse industry trends in safety performance. That was put in place in about 1998/1999. NRR picked that up in 2000 from research, and we implemented the ITP in 2001. One of our key outputs is to make sure we address this performance goal measure.

CHAIRMAN APOSTOLAKIS: So the key words here are "statistically significant," right?

MR. BOYCE: Well --

CHAIRMAN APOSTOLAKIS: Because you can have a single event that is risk significant, but then that's because it's a single event it will not fall under this, would it?

MR. BOYCE: Right. There's a second performance goal measure which we think would capture that on the Accident Sequence Precursor Program.

CHAIRMAN APOSTOLAKIS: Yes, that ASP.

MR. BOYCE: Right. And so in terms of reporting to Congress and addressing the issue, that would be covered. It would remain to be seen the contribution of that individual event to changes in the industry indicators.

CHAIRMAN APOSTOLAKIS: Yes, but then we wouldn't call that a trend if it's a single --

MR. BOYCE: That's correct. It would probably be an outlier, which I think was your -- I think you brought that up in the Subcommittee, the Davis-Besse example.

CHAIRMAN APOSTOLAKIS: Within four days I can be consistent.

MR. BOYCE: The two purpose of the program are align with the NRC strategic plan and the first is to provide a means to confirm that the nuclear industry is maintaining the operating and safety performance of nuclear power plants. And the second is by clearly communicating that performance to enhance stakeholder confidence in the efficacies of the NRC's processes.

Speaking of communications with stakeholders, this is how we do it. We put the industry indicators up on the NRC's web site. Those were first put in August of last year. They were taken down temporarily post-9-11, and they're back up as of a few months ago. We provide an annual report to the Commission. We've provided two reports so far. One was in June of 2001 and one was April of this year. I believe you have copies of both of those Commission papers.

We provide an annual report to Congress as part of the NRC's performance and accountability report. And, finally, these indicators are presented at various conferences with industry. A most recent example might be the Regulatory Information Conference in March, the American Nuclear Society presentations and several others I'm aware of.

This slide depicts the process for identifying and addressing industry trends. In general terms, we apply statistical techniques to each of the indicators in the program, and we look for what amounts to an upward trend in any of the trend lines. If we saw an upward trend, we would take a look at the underlying issues and assess the safety significance. For example, if SCRAMS were to go up, as Pat alluded to earlier, there's many reasons for SCRAMS to go up, but that would be our first indicator that we need to go take a look at the underlying causes.

Based on what we found and the safety significance of what we found, we would then take the appropriate Agency response in accordance with our processes for addressing generic issues. These processes are the generic communications process in NRR and the generic safety issues process in the Office of Research. Finally, there's an annual review as part of the Agency action review meeting, and this is a group of senior managers of the NRC.

This is a snapshot of the results of the ITP for fiscal year 2001. Bottom line, we have identified no adverse trends based on eight indicators that were developed by the former Office of AEOD as well as the Accident Sequence Precursor Program. We are trying to develop additional indicators that are derived from the plant-specific information submitted as part of the ROP. They would cover all the cornerstones in the reactor oversight process. We initially kicked off this program in April of 2000, so we do not yet have four years worth of data. However, we did --

MEMBER POWERS: You mentioned the ASP Program, that you didn't find any trends. Did you happen to look to see if there was any trend for shutdown accidents to be more or less prevalent than they had in the past? The ASP important accident events.

MR. BOYCE: I'll take the first cut and then perhaps Pat will fill in. As part of the industry trends program, we use a single indicator which is total counts of ASP events, and so shutdown events would just be a small subset of that, we hope. And there was --

MEMBER POWERS: A big subset of that?

MR. BOYCE: Well, actually, I don't know because we didn't look into it, but Pat's group produces a separate SECY paper for the ASP Program, SECY 02-041, I think, was the most recent one. I don't know whether that issue was addressed as part of that Commission paper.

MR. BARANOWSKY: Yes. We do look at shutdown events in more of an ad hoc manner, because we don't have the tools for shutdown analysis that we have for the at-power conditions.

MEMBER POWERS: Why don't you have those good tools?

MR. BARANOWSKY: We're trying to develop them based on resources available.

MEMBER POWERS: Why don't you have more resources available?

MR. BARANOWSKY: You would have to talk to the powers that be.

MEMBER ROSEN: He is the powers that be.

(Laughter.)

MEMBER POWERS: What particular suite of language should appear in our research report that would say these guys have been struggling along unable to analyze shutdown precursor events with any kind of adequacy, and they need the tools to do that better, and therefore should have resources to do that better.

MR. BARANOWSKY: To be fair about it, if that was said a few years ago, we probably would have the tools now, but we are embarked on getting those tools in place. I don't know that we could go any faster than we can right now, because we have to have people who can manage the work and who can do the work, and there's just limits to who's available.

MEMBER POWERS: I've heard that story for four years, Pat.

MR. BARANOWSKY: I don't think so.

MEMBER POWERS: We're working on this stuff, we're working on this stuff, we're working on this stuff.

MR. BARANOWSKY: We actually have schedules now.

MEMBER POWERS: And I've got Steve over there telling me that the world -- the spin angular momentum of the Earth is about to come to an end if we don't put better attentions to shutdown risk.

MEMBER ROSEN: Dana always exaggerates the importance of my remarks. I'm grateful but it's not quite the spin angular momentum that's --

MR. BARANOWSKY: The shutdown risk, from what we've seen, is not 50 percent of the accident sequence precursors, and I'm fairly confident that it's not that high.

MEMBER ROSEN: What did you say?

MR. BARANOWSKY: I don't believe it's 50 percent.

MEMBER ROSEN: Of what you've seen so far.

MR. BARANOWSKY: Of what I would see if I did even a really complete accident sequence precursor analysis.

MEMBER ROSEN: Your zero information guess it would be one-sixteenth of the set of ASP events. So I mean if it's anything more than a sixteenth, Steve's probably right.

MR. BARANOWSKY: Yes.

MEMBER ROSEN: The spin angular momentum of the Earth is --

MR. BARANOWSKY: It's about 20 percent or so, it looks like.

MEMBER ROSEN: I've got a calculation for you right now. It only applies -- the real risk is PWR. Two-thirds of the plants are PWRs. It's half of the risk of two-thirds.

MR. BARANOWSKY: I'm saying around 20 percent.

MEMBER ROSEN: That's two-twelfths, right?

CHAIRMAN APOSTOLAKIS: Two-sixths.

MEMBER ROSEN: No, two-sixths, right, half of the risk of two-thirds.

CHAIRMAN APOSTOLAKIS: Which is one-third.

MEMBER ROSEN: One-third.

MR. BARANOWSKY: Which is well within the uncertainty.

MEMBER POWERS: Yes. And the zero information guess would be six percent.

MEMBER ROSEN: Right. Define high. I say it's six times that.

MEMBER POWERS: Yes. So you're saying it's six times that. And these guys don't have the tools to analyze it exactly. I mean, you know, if I were you, I would really complain. You're just not getting the support you need.

MR. BARANOWSKY: Well, as I said, we are developing the tools now. I believe the Commission has pretty much said we need to get on with developing the accident sequence analysis capabilities and SPAR models for the spectrum of capabilities --

MEMBER SIEBER; When do you shutdown?

MEMBER POWERS: When do we see the shutdown?

MR. BARANOWSKY: I believe so because we've provided that in our budget discussions, and there seems to be support for it.

CHAIRMAN APOSTOLAKIS: Shutdown and fire what?

MEMBER SIEBER; Shutdown and fire and

operations is, in my opinion, guessing -- a third, a third, a third.

MEMBER ROSEN: That's the whole --

CHAIRMAN APOSTOLAKIS: Is that what the Commission said, Jack.

MEMBER SIEBER; That's what I'm saying.

CHAIRMAN APOSTOLAKIS: Oh, you're saying that.

MEMBER SIEBER; So fire and operations.

MEMBER POWERS: Let me ask a question. Where would I go to look at the program plan for developing these tools?

MR. BARANOWSKY: That's excellent. I believe we've supplied, but we'll supply you again, with the SPAR model development plan, which includes this information, and I can guarantee you'll have that shortly.

MEMBER POWERS: And I'll be just delighted and thrilled.

MR. BARANOWSKY: You'll call me up you'll be so delighted.

CHAIRMAN APOSTOLAKIS: And the spin angular momentum of the Earth will be preserved.

MR. BARANOWSKY: Preserved.

MR. BOYCE: All right. Thanks for

fielding that one, Pat.

MEMBER POWERS: Now, wait, you don't get away scott-free here.

MR. BOYCE: Oh. Well, I'm sure there will be other opportunities.

MEMBER POWERS: Okay. What about the inspection force? What kind of information do they get?

MR. BOYCE: Well, you're right, I didn't want to draw fire, but I did want to say that we're not just doing PIs as part of our oversight of licensees. We do have inspectors that go out in the field and are looking very closely at these things, and we do have inspection procedures that are tailored to shutdowns. Part of that inspection process --

MEMBER POWERS: Okay. So they find something now. They want to do a significance determination process. What do they do?

MR. BOYCE: Well, there is a shutdown SDP. There are many deficiencies in that shutdown SDP.

CHAIRMAN APOSTOLAKIS: Based on what? How did they develop it?

MR. BOYCE: Perhaps we can come back on this before I --

CHAIRMAN APOSTOLAKIS: Yes. Okay. I

think we should.

MR. BOYCE: -- get in trouble here. But --

MEMBER POWERS: Well, I think you should -- you and Pat ought to get together and go complain to the powers that be. You're not getting the support you need.

CHAIRMAN APOSTOLAKIS: Well, if there has to be any complaints to the powers, I want to add a couple things.

(Laughter.)

CHAIRMAN APOSTOLAKIS: Whoever has the most power will maybe have a meeting about complaining.

MR. BOYCE: Let me point out another, perhaps, weakness in our program right now. The performance goal measure talks -- really only looks at trends, and if you look at the indicators that we have right now, they start in about 1998 -- 1988, excuse me. And those trends, most of them show an exponential type of decay, and some of the indicators might be approaching asmototic limits in terms of improvements in performance. It's very difficult to say that for sure, but that's what it looks like it appears. And so it's inevitable that at some point we'll have a trend line that goes up. And what we're trying to do is rather than be tied to our process that would have us react to something that may or may not have safety significance, we're trying to establish thresholds based on the safety significance.

An example would be SCRAMS. Right now, we're averaging about 0.85 SCRAMS per plant per year, whereas back in 1988, plants were averaging on the order of two and a half to three SCRAMS per plant per year. So if there was an uptick of 0.85 to one, we're not sure that that would be a change in the safety performance of the plants, and so we're trying to establish a rational basis. And that's most of the development work that's ongoing, and I'll get to that in just a second.

If we are able to develop these more risk-informed thresholds and get them in place, it would enable us to change the performance goal measure to something similar to what the Accident Sequence Precursor Program uses, which is something like no more than one ASP event per year. It would mean no more than one indicator exceeds a certain threshold per year, just to provide an example of our current thinking.

Finally, we're also developing additional indicators that we might be able to use in the program. An example is we developed on the order of 15 initiating event indicators. Those were provided in SECY 02-058, which I think you have a copy of. And we're taking a look at those and seeing the applicability of the program. One of the -- for example, steam generator tube ruptures is a very infrequent event that you can't really monitor well on a plant-specific basis, but you can do a lot better monitoring them on an industry level, so we're taking a look at those.

MEMBER POWERS: And it's really remarkable, because when you look at that -- and, like you say, you can't ask real detailed questions because it doesn't happen often enough to do that -- but if you take broad integrals, it's constant. It's a constant rate of steam generator tube ruptures. I mean it defies logic. I mean you would think it would go up as steam generators get old, but it doesn't seem to.

MEMBER ROSEN: Well, that's because a lot of steam generators are being replaced. They're not getting older, on average.

MEMBER POWERS: But there was a period of time they were.

MEMBER ROSEN: Well, that's true.

MEMBER POWERS: And it didn't change.

MEMBER ROSEN: But that's because the industry made heroic efforts to avoid those kinds of things in that time period.

MR. BOYCE: And I think the NRC oversight helped and contributed, just to put in a plug.

(Laughter.)

MEMBER ROSEN: This had something to do with it and that's the degree of heroism required.

MR. BOYCE: A lot of these initiating events were based on the work that was done earlier in NUREG 57.50, if you're familiar with that NUREG. And we're also trying to bring up to date some of the system reliability and component reliability studies that research has done in the past.

The rest of this presentation describes where we are in terms of threshold development, and what we'd like to do is just give you an introduction here and then come back sometime this fall to give you more details on where we are. We would probably piggyback with the MSPI work that's being done. I'm not sure we need at least two more presentations, as Pat talked about, but we'd definitely like to come back.

CHAIRMAN APOSTOLAKIS: In November.

MR. BOYCE: Probably the most important bullet here to take away is that industry thresholds differ from plant-specific thresholds in that while we're working on models for each of the plants and we're getting there, there isn't an industry-level model right now, and so the challenge is to come up with a rational way to get an industry-level risk.

MEMBER POWERS: Maybe I didn't follow. Why would I want to have this?

MR. BOYCE: Well, what we're trying to do is get to the -- if you have a model to use -- well, we don't have a model, but what we're trying to get to is risk-informed thresholds.

MEMBER POWERS: But why wouldn't I want to make those -- I mean I'm surprised that Dr. Apostolakis isn't climbing down your throat right now saying, "The one thing that we've learned in all of our risk studies is it's very plant-specific." Why aren't you climbing down his throat, Dr. Apostolakis?

CHAIRMAN APOSTOLAKIS: I wasn't paying attention.

(Laughter.)

MR. BOYCE: Well, I think I --

MEMBER ROSEN: Let me suggest a different strategy perhaps or a strategy. But is it not true that the risk of the industry today, a snapshot, is the sum of core damage frequencies over all the plants divided by the number of plants?

MR. BOYCE: That's, in essence, really what he's talking about, and that's why, for instance, when you trend steam generator tube ruptures, you know, they're made of all individual plants and hardly any of them have tube, but you want to know what's happening in the industry, you look at the collection, but it has to be in a risk context so that when you count these things you don't weigh things way out of balance incorrectly. So I'm agreeing with what you're saying. I don't have all those models in place. I think I was agreeing.

MEMBER POWERS: He's just giving you a real nice model. He says get the industry by doing the plant-specifics and selling.

MR. BOYCE: Actually, that is one of our options that I'll get to. Some of this is a --

MEMBER POWERS: Why would you want to do anything different?

MR. BOYCE: Timing. We need something in place sooner. The SPAR models aren't going to be available, and licensees, PRAs may give slightly different results than the SPAR models, and we need to come to agreement with all the stakeholders as to what constitutes the appropriate model to use. So we're trying to get thresholds sooner. It may be that we do get to exactly what you just described.

MEMBER ROSEN: I'm not sure I understand your -- I don't know whether your answer -- understand your answer. I mean after all, you can call up the risk supervisor at each plant and ask him what his current CDF is. Of course, it changes as they do Bayesian updates, but you could get a snapshot. He'd say -- and you'd have to make your question quite specific. You'd say, "Give me your best shot at your internal events plus shutdown where your interval events, if it includes fire, not giving a separate fire number." So the guy gives you three numbers and you add them up and you do that to the next plant. Now, there are some plants that are not going to give you all those numbers. You have to have a little asterisk in your column where you make an estimate maybe, but at the bottom of the line, you're going to -- at the end of this, you're going to construct a table and you're going to press a button and it's going to add it up --

CHAIRMAN APOSTOLAKIS: Isn't that already in the IPE?

MEMBER ROSEN: IPE, so, you know.

CHAIRMAN APOSTOLAKIS: Well, we start with that, but then we make the phone calls.

MEMBER ROSEN: Yes, you make the phone calls, because IPE is so far out of date, you know, that was 1988. It's 20 years --

CHAIRMAN APOSTOLAKIS: That's when the letter came out, the IPEs were done later. But you're right, I mean there will be updates and so on. But the point is that you can have a table tomorrow.

MEMBER ROSEN: Yes.

CHAIRMAN APOSTOLAKIS: And then start calling people to --

MEMBER ROSEN: Well, yes. You could have a table from IPE tomorrow or you could have -- in two weeks, you could have this other table.

CHAIRMAN APOSTOLAKIS: That's correct.

MR. BOYCE: Okay.

CHAIRMAN APOSTOLAKIS: My experience with this thing is that it takes about two and a half to three years for people to go to plant-specific stuff. I don't know why. Look at the ROP. Now they're talking about plant-specific. This is a semi-empirical observations.

MEMBER ROSEN: But what is it that takes two and a half years? I'm asking.

CHAIRMAN APOSTOLAKIS: They initial the system.

VICE CHAIRMAN BONACA: If we keep this way, it will take two, three years to finish this up.

CHAIRMAN APOSTOLAKIS: And that will be -- okay, let's move on.

MR. BOYCE: The other thing I'd like to point out is this approach lends itself most readily to the initiating events in mitigating systems cornerstones. There's five other cornerstones where we do need to develop some sort of indicator, and those other cornerstones, as examples, are things like occupational radiation exposure, public radiation exposure, emergency preparedness, safeguards and physical security. And the approach that we're talking about here it would not be applicable in those cornerstones.

So having said that, what we're going to try and do is develop a -- jump ahead on my slides -- develop an expert panel where we would build on the work done in the initiating events and mitigating systems cornerstones and see how it might apply to the other cornerstones and try and look for consistencies in approach, not just risk approach but also statistical approach.

So bear with me and let me complete the presentation. In concept, we're looking at a couple of different kinds of thresholds. The one we've talked about up to this point could be termed an action threshold. It's where we actually take an Agency response, a preprogrammed Agency response and we would also report it to Congress. We could also contemplate more of a lower threshold which would give us more of an early warning that there is something developing. And this might -- we're not really sure how we might use it, but it might lead to information notices sent out to industry or perhaps generic safety inspections by the staff. In addition, we may continue to monitor trends so that we can identify issues before it manifests themselves as safety problems in our indicators. Next slide.

Here's some of the characteristics we'd like in thresholds. Next slide. This slide talks about the process for establishing the thresholds. The important element here is we're going to establish an expert panel, give them inputs from risk and statistical information. We're going to have experts on that panel in each of the cornerstones, and we're going to try and come up with a rational basis for establishing the thresholds.

CHAIRMAN APOSTOLAKIS: You know, as part of the input to the panel, you can do what Mr. Rosen suggested, develop the table, plant-specific stuff, and give it to the panel and let them process it.

MR. BOYCE: Right.

CHAIRMAN APOSTOLAKIS: That would be a simple thing to do. If they decide to come back with generic thresholds, then that's their judgment, but I doubt it. But they probably could --

VICE CHAIRMAN BONACA: You'll have apples and oranges in that table. That was the only --

MEMBER ROSEN: Yes. There's a lot of apples and oranges now.

CHAIRMAN APOSTOLAKIS: What if you have generic thresholds, then what do you do? You take the apples and oranges and make a fruit salad.

VICE CHAIRMAN BONACA: I understand. All I'm saying is if you get an expert panel, let them -- hopefully they'll be expert enough to try to sort out --

CHAIRMAN APOSTOLAKIS: But they don't have access to this information. Not every expert reads the summary reports. This is just an additional input and let them take care of it.

MEMBER ROSEN: One comment on apples and oranges. The peer certification process is making it more like apples like two kinds of apples: Granny Smith apples and red delicious apples. Because it's forcing a convergence of the numbers, so that's a good thing.

MEMBER POWERS: Yes. Well, I think George would argue that it's forcing a convergence to crabapples.

MEMBER ROSEN: Well, having gone through one recently, I know for sure that it's forcing improvements. Now, if it's forcing improvements as much elsewhere as it was in the plant that I'm familiar with, then that's a good thing.

MEMBER POWERS: The ones I'm familiar with you're right, it's certainly forcing some people to make some -- I mean I think everybody ends up having to make some changes and improvements in their PRA. But I think George would argue it's improving to a consistent level of mediocrity.

MEMBER ROSEN: I don't think so. Hossein, what do you think? You know the peer process pretty well.

MR. HAMZEHEE: I'd rather be quiet today.

(Laughter.)

MEMBER ROSEN: I don't want you to. You know too much. I'd like to hear what you think.

MEMBER POWERS: I mean I think the point that George would make if he weren't being so quiet over there --

CHAIRMAN APOSTOLAKIS: Shy, I'm shy.

MEMBER POWERS: -- uncharacteristically quiet, retiring, is there is not yet such a strong incentive for the licensee to lean forward in the trenches in PRA technology, because the benefits are not so transparently coming to him.

MEMBER ROSEN: Yes. I think that's true about leaning forward in the trenches, doing new things, and that's a little bit why I was proselytizing about the selection of the usual suspects in previous presentations. But as to coming up to the level that's expected in the peer certification, that is happening, so there's a push there or a pull up to that level. Beyond that, yes, you're correct, there's not a whole lot of incentive to --

VICE CHAIRMAN BONACA: On the other hand, we have groups of plants out there, okay, where if you go and look at their stuff, they have to support the development and dimensions of the PRA. They have roughly one person here or less oftentimes versus this program, some of them have had four people assigned to one plant for ten, 15 years. And that is not changing. That's where I'm saying --

MEMBER ROSEN: That's where you're wrong. I think what's happening in the industry is there is more manpower going into this across the board.

VICE CHAIRMAN BONACA: I'm not denying it is increasing but just two years ago we went to see a plant and we had one person there. And we're talking about Davis-Besse, and now you're about to bring Davis-Besse into this process.

CHAIRMAN APOSTOLAKIS: It was amazing the kind of stuff he was promising to do.

VICE CHAIRMAN BONACA: Yes. It was amazing what they promised that they would do by October, including the update and everything else. What I'm trying to say -- and I don't want to make point of Davis-Besse -- what I'm saying is there's an unevenness there that still are --

MEMBER ROSEN: Yes. It's clear that there's an unevenness, but I think that the trend is in the right direction across the board. There will be places where it's very uneven. And it's to the point that it's a Level 3 with one person. When you get two people, then you realize you can only do a Level 2. You get six people, then they start complaining they really can't do the Level 1 right.

CHAIRMAN APOSTOLAKIS: It goes back.

MEMBER ROSEN: And when you have South Texas with a dozen people, then the whole thing's a mess, because that's when they find all the problems.

CHAIRMAN APOSTOLAKIS: We are really running out of time here.

VICE CHAIRMAN BONACA: Can we please -- yes, let's complete this presentation.

CHAIRMAN APOSTOLAKIS: Do you have any conclusions?

MR. BOYCE: That we'll come back to? These are some of the technical approaches. Some of them are statistically based, some of them are PRA-based. One intriguing one is to follow the example set at the MSPI and perhaps, and Pat alluded to it, we develop a roll-up indicator for the initiating events. We have right now on the order of 15 initiating events, and we may be able to roll them up into a single index. That's tipping our hand a little bit. We're exploring that heavily right now. Or some combination of the above. And we'll get back to you.

CHAIRMAN APOSTOLAKIS: Good.

MR. BOYCE: Here's some of the technical questions. I won't go through them, but there are several questions that have been brought up as part of this forum that we also need to look at.

CHAIRMAN APOSTOLAKIS: Why does Congress want this information?

MR. BOYCE: Well, I'm not sure I have the background answer to that question, but --

CHAIRMAN APOSTOLAKIS: What do they do with it?

MR. BARANOWSKY: I can answer it. It's required of all agencies through the performance and accountability reporting requirement to pick agency-wide performance indicators that are a measure of how well we're doing.

CHAIRMAN APOSTOLAKIS: Oh, so it's just an --

MR. BARANOWSKY: For instance, the FAA might have certain accident or near-miss rates that they track. We track precursors, we track performance of plants and other things, there's a lot of things. And so we're required by law to do that.

MR. SATURIUS: And we picked them. We did it to ourselves. We picked the no significant adverse trends as a reporting requirement.

CHAIRMAN APOSTOLAKIS: Okay.

MR. BOYCE: That's part of the GPRA, Government Performance and Results Act of 1993. My answer was why does Congress want to know about all the details that we're providing at a high level if we exceed one of these thresholds, and it's to keep them aware of what's going on in the nuclear industry.

CHAIRMAN APOSTOLAKIS: Okay.

MR. BOYCE: All right. Schedule? This you've not seen before. At the Subcommittee, we didn't have this particular slide. But we've asked Research to give us thresholds for the first two cornerstones by the end of July. We would digest those, interact with stakeholders from industry, we'd come back to the ACRS and we would try and use those and, as I said, expand the approach as it can be applied to the other cornerstones.

We think we'll have thresholds for the other cornerstones in about the September time frame. We're going to be looking at changing the performance goal measures sometime this fall. That would be part of the budget process. Somewhere in here we're going to be coming back to the Subcommittee, and, again, that would be piggybacking on the MSPI. We've got our annual Commission paper in March of next year, and we think we'll have final thresholds developed an in place sometime during FY '03. That would conclude my portion of the brief.

VICE CHAIRMAN BONACA: And we'll be glad to have an update in the fall, piggyback on the other one, performance indicators. Thank you for the presentation. Any questions? If none, back to you with ten minutes.

CHAIRMAN APOSTOLAKIS: We did? Okay. Thank you very much. We'll recess until 4:10.

(Whereupon, the foregoing matter went off the record at 3:56 p.m. and went back on the record at 4:12 p.m.)

CHAIRMAN APOSTOLAKIS: Quiet. The last topic of the day is technical and policy issues related to advanced reactors. Dr. Kress will Chair the session.

MR. KRESS: Thank you, Mr. Chairman. The fact that we have such high-powered and respected people here attests to the importance of this issue. You know, with the new technology in advanced reactors, it may be difficult to figure out how to fit them in to the current licensing system. And in the process of doing so, there are a number of policy and technical issues that will have to be faced up.

And, you know, I've articulated a number of these in the past, and the staff is making some studies to I think go to the Commission with, and say, "These are the policy issues that we need to resolve before we can proceed to license or certify these advanced reactors." So we're going to hear about the -- I guess it's still a preliminary document this time, and I guess either Ashok or Farouk is going to start us off.

MR. ELTAWILA: I see that Ashok is the lead presenter, so I'm here to support him.

(Laughter.)

MR. THADANI: Not correct. We'll take care of that in a moment. Farouk is actually going to go through the presentation. But I do want to share some thoughts with you. We had a -- we briefed the Commission on March 19 on research programs and again towards the end of May, and Tom participated in that meeting -- Commission brief on advanced reactors. One of the things I noted during our brief was the absolute importance of making sure we lay out, particularly for non-light-water reactor technologies, we lay out a clear understanding of what our expectations are in terms of safety. And you'll hear a little bit about safety goals, their incompleteness and a number of issues related to the whole concept of defensing that.

And I indicated that the point that it would take great deal of intellectual capital to be able to develop these things, and they would require -- my view is they would require interaction and discussions with a number of people who have had considerable experience in sort of thinking about these safety principles and where is the country going. What is really meant by this expectation that the future reactors would be safer than the current class? What does that really mean?

So we've just started. We're looking forward to, I think, considerable dialogue with you, and we'll be talking to others. We're looking at some options of what sort of help we need to get to go forward in this particular area. And then there are the technical issues. Our intention is to get some information up to the Commission fairly soon, but we do need to get the research plan to the Commission I think it's fall of this year. And before we do that, we would like to have some of your thoughts reflected in the paper that we'd like to send to the Commission.

With that, I think Farouk is going to

raise all the key points.

CHAIRMAN APOSTOLAKIS: When is the paper going up, Ashok?

MR. THADANI: I think fall of '02.

CHAIRMAN APOSTOLAKIS: The fall?

MR. THADANI: Do we have a date?

MR. ELTAWILA: The final paper is last day of fall, so December 22. Christmas.

(Laughter.)

CHAIRMAN APOSTOLAKIS: This is the only ACRS meeting?

MR. ELTAWILA: No, no. This is what we send you a pre-decision, a copy of that paper for your consideration. That paper is going to the Commission this coming June just to try to scope the problem and the issue that we are working on. And then we'll have public workshop, discuss the issue in public workshop, have another discussion with you.

So just to start wit the discussion here, this is an outline of my presentation. I'm going to start with the purpose of the briefing and give you some background about some of the advanced reactor issues that we are working on. And as Ashok indicated, the Commission has certain expectations about enhanced margin of safety for advanced reactor, so I'm going to touch on that briefly. And I'm going to discuss relationship to international center.

In this presentation and in the paper that you have, we focus on five policy issues that have technical basis, but there are a lot of other policy issues that are addressed in other Commission papers. I'm going to touch on them, but I'm not going to get into them in detail.

The five policy issues here, the reason we group together in this paper, because they are all interrelated. If you work on one of them or any decision that we make on one of them will affect the other decisions. That's why we would like to address them in group. And then I will discuss our future plan later.

MR. KRESS: Farouk, I presume among those five issues assume among them would be the role that PRA and high-level risk acceptance criteria might play. That's cross-cutting through all of them.

MR. THADANI: Yes. And it is one of the major issues.

MR. ELTAWILA: That's the first issue, event selection and role of PRA that's embedded in that issue.

MR. KRESS: That's embedded, yes.

MR. ELTAWILA: And we have Scott Newberry and Mary Drouin here to help me if I stumble on anything.

The purpose of the briefing, I think we -- originally, we thought that we are going to wait until we finished the pre-application review of the Exelon PPMR before we go to the Commission on Policy Decisions. With the cancellation of the PPMR, we recognized that I think that these policy issues are of vital importance to the advanced reactor type of the gas reactor type, the PBMR and GT-MHR. And we have done work in the past in this area.

So based on the work that we have done thus far with Exelon and the work that we have done in the '80s and '90s on other advanced reactor type like the CANDU and MHTGR, that's the old GE design, we believe that we have sufficient information right now to go to the Commission with our recommendation on the policy issue.

CHAIRMAN APOSTOLAKIS: But did the Exelon action have any impact on the policy issues that you are proposing? I mean it seems to me that you have more time now, don't you?

MR. ELTAWILA: We don't believe -- we have more time, but I think it will be much better if the

Commission makes its expectation clear. If we make our expectation clear, what is this future design going to look like, what's the capability that we require of this design, the designer will be able to cope with that and incorporate them in their design. If we wait until we have a design here to review, our decision might impact them and cause a backfit and things like that. So it's better.

CHAIRMAN APOSTOLAKIS: It's better because you have more time to think about it.

MEMBER WALLIS: Well, I think it's very appropriate that you set the rules before the design.

MR. ELTAWILA: That's what we're trying --

MEMBER WALLIS: Because the safety would be enhanced, because they will design to the rules, not to try to fix them after.

CHAIRMAN APOSTOLAKIS: You used the word, "cancellation." I'm not sure that's what Exelon used.

MR. THADANI: No, it's not cancellation. It's that they're getting out of this business. But let me -- I'm glad -- the points that Graham are very important. You recall we talked to you about the vision and mission of the Office of Research some time ago, and in that is one element which is making sure the Agency is prepared for future challenges and is not an impediment to any specific technology in terms of saying -- someone comes to the table and we say, "Well, it's going to take us seven years." So it is essential for us, we believe, to go forward and for us to be setting some ground rules, which the designers, as Farouk noted also, can take advantage of. There would be -- I think this actually is a much more stable way to go forward.

CHAIRMAN APOSTOLAKIS: Yes. But my point is that if you had an application, say, coming in the next year or so, then you look at these policy issues perhaps with a different eye, and say, "Well, gee, how much of the current system can I use, " and so on. And now that you have a little more time, it seems to me the policy issues should be a little different, and they should be really what they ought to be.

MR. THADANI: Yes. And one other piece of information I want to give you is I have talked to the Department of Energy to get their sense of what they see future is going to look like.

CHAIRMAN APOSTOLAKIS: Right.

MR. THADANI: And they continue to tell me, I've had discussions with Bill Magwood. He continues to tell me that he sees the gas cool technology in the future for this country. So he still believes it's an important element.

MEMBER POWERS: Ashok, Magwood's just come down with his definition of what his Gen-4 reactors are, and he's come up with six. He's got a gas coolant fast reactor, he's got a -- are you ready for this, Tom?

MR. KRESS: I know what you're saying.

MEMBER POWERS: A molten coolant reactor.

MR. KRESS: Yes.

MEMBER POWERS: He's got a --

MEMBER ROSEN: Liquid metal reactor.

MR. KRESS: Yes.

MEMBER POWERS: -- metal reactor. He's got something called a lead battery, which is kind of hilarious. Super critical water reactor, and then he's got the one that's the cat's meow of them all, a very high temperature gas reactor.

MR. KRESS: Right.

MEMBER ROSEN: Remember, those are reactors that their Gen-4 Program has been studying and for implementation into 2030. This is not next year.

MR. THADANI: That was going to be my point. There's a distinction here, and Bill Magwood made a presentation recently, I think to the

Commission also, and he pointed out what he believes over the next ten years is likely to happen. And then Generation 4 basically is 2030 to 2050 is what --

CHAIRMAN APOSTOLAKIS: Just about the time when we'll retire, right?

MR. THADANI: I want to enjoy a few years of my life.

(Laughter.)

MR. KRESS: But I think the policy issues that you selected address all those reactor types.

MR. THADANI: That's exactly right.

MEMBER WALLIS: George, you can tell your grandchildren then that you had a role in making this possible when it happens.

CHAIRMAN APOSTOLAKIS: What do you mean? I'll still be on the ACRS.

(Laughter.)

CHAIRMAN APOSTOLAKIS: Let's go on, Farouk.

MEMBER ROSEN: But I want to be sure -- before you go on, I want to be sure that the outcome of that is, I understand, is that we're going to move forward in a way to enable those things to be possible, not just look at gas-cooled pebble bed reactors. Is that correct?

MR. THADANI: Yes. I think a lot of this will really aid, not just in terms of gas-cooled technologies but other technologies as well, yes.

MEMBER ROSEN: It should.

MR. ELTAWILA: I want to make a point here that these five issues are not new. We have interacted with these issues with another ACRS committee in the '90s and the Commission, and we issued the SECY 93-092, same five issues. And the Commission approved the staff recommendations in an SRM dated July 13, 1993, but because of the change in Commission, the ACRS, the staff and our experience with risk-informed regulations, all of these led us to go and revisit these issues, put them back in front of you. We'd like to get your feedback and then go to the Commission with either the same recommendation or different recommendation, but they are not new issues.

MR. KRESS: Yes. The resolution of those issues were LWR-specific, as best I remember, back in '93.

MR. ELTAWILA: And they were written in terms of the CANDU, the MHTGR, or whatever it was, and the Pius. So they were really for the advanced reactor in general, not for the light- water reactor. We would like to have a continuous interaction with you. For example, at this stage, what we'd like for you to see if we identified this issue, provide enough clarity about them and what is your views about them? Eventually, it will come back to you after we have interaction with the stakeholder and discuss our final recommendation to the Commission. Whether you send us letter now or towards the end, that's completely up to you.

CHAIRMAN APOSTOLAKIS: At the end, you will want one.

MR. ELTAWILA: We definitely will want one at the end, but if you want to send us one right now to help us, that would be --

MR. THADANI: We would appreciate it, certainly, even if you have any views that you want to put forth, be they in our discussions or if you want to advise the Commission if you disagree with anything that we say here or in the paper.

MR. KRESS: We can certainly do that. I don't know if we can address that third sub-bullet under the third bullet yet, but we can give you comments on the first two sub-bullets.

MR. ELTAWILA: Okay. That would be great. As I indicated earlier, we have other activities where we are developing a risk-informed performance-based regulatory framework. That will be a technology-neutral framework so we can use it for any kind of reactor design. I'm not going to talk about it here, but it's going to be a part of the RIRIP updates that's due to the Commission in June of this year.

MEMBER SIEBER; I would hope that it's not a two-stage either/or system between deterministic and risk-informed for advanced reactors. I would like to see it just risk-informed to sort of force the context into that kind of thinking as opposed to giving alternatives.

MR. ELTAWILA: It's not alternative. It's together, I believe, that's whenever it's possible that you can use the performance-based regulatory framework --

MEMBER SIEBER; That would be the requirement to use that.

MR. THADANI: I think, certainly, there will have to be some sort of high-level risk-informed approach.

MEMBER SIEBER; Right.

MR. THADANI: But that -- when you go to some specific designs --

MEMBER SIEBER; There will be determinants.

MR. THADANI: -- you might find there is such limitations --

MEMBER SIEBER; Right.

MR. THADANI: -- in trying to meet those high-level goals that you may have to resort to some other considerations.

MR. SALSBERG: No, but you won't have alternative rules.

MR. THADANI: No. Our intention is not to have alternatives.

CHAIRMAN APOSTOLAKIS: And there will be no two-track system.

MR. THADANI: No.

CHAIRMAN APOSTOLAKIS: Two-tier system.

MR. THADANI: That's not the intent.

MR. ELTAWILA: Just for background information, we completed the preapplication review for the AP-1000, PBMR preapplication activities. We are continuing to work with Exelon, trying to close out and document where most of the information that we received on our request for additional information. We expect additional preapplication activities, like GE is meeting with us sometime this month about GE-ESBWR, which is a 1,200 megawatt electric, which builds on the ABWR and on the SBWR that was under review here at the Commission a few years ago. And Framatome is proposing SWR1000 and another is NG-CANDU, which is new generation CANDU. So all these are preapplication that's on the horizon, so the staff will be --

CHAIRMAN APOSTOLAKIS: Why do you say they're possible? Do you have any indications of anybody that they might actually come?

MR. ELTAWILA: They are all -- GE-ESBWR is coming to discuss --

MR. THADANI: They sent a letter in April.

MR. ELTAWILA: Yes, they sent a letter in April. We have a meeting with them this month. We had already a meeting with Framatome, and we're planning to have another meeting with them in August. NG-CANDU, or AACL, they are coming June 19.

CHAIRMAN APOSTOLAKIS: Oh, so there is already contact.

MR. ELTAWILA: There is a contact with these --

CHAIRMAN APOSTOLAKIS: What does ESBWR stand for?

MR. ELTAWILA: European Simplified Boiling Water Reactor, but eventually it will become Economics Simplified Boiling Water Reactor.

(Laughter.)

CHAIRMAN APOSTOLAKIS: So they will apply for a green card, I assume. The European reactor will apply for a green card?

(Laughter.)

MR. ELTAWILA: That's one of the policy issues that we need to discuss.

CHAIRMAN APOSTOLAKIS: It's a policy issue.

MEMBER ROSEN: We'll ask them if they have any business here, and they'll say, "No, not yet." And we'll say, "Well, come back when you do."

MR. ELTAWILA: Again, many of the issues that developed in the course of our review have resulted in generic policy implication, like the legal and financial issue, and we issued a SECY paper. We are planning to provide the Commission in the June time frame with a technical paper in conjunction with the policy papers. So to facilitate a policy decision, we want them to see the underlying technical basis for our recommendation.

VICE CHAIRMAN BONACA: What is the NG-CANDU?

MR. ELTAWILA: New generation CANDU. That's --

MR. THADANI: As I understand, it's slight enrichment -- I think they're moving away from natural uranium. And we would certainly be interested in getting better understanding of things like the coefficient and so on.

VICE CHAIRMAN BONACA: Yes. That was the one that has to be no good.

MEMBER FORD: I have a question. With all these reactors coming up for reapplication, how many of them can you in fact address, given the people, the resources you have?

MR. THADANI: Let me -- right now, there is a significant issue about budget. Obviously, the Commission has not made any decisions about 2004 budget, and they may want to make some changes even in 2003 budget before the Appropriations Committee does its thing for 2003 budget. Our plans currently do not include consideration of -- review of any designs other than an HGDR and AP-1000, and we have some limited resources we've identified in the outyears. I think it was -- Farouk, you'll have to correct me -- Iris, I think we put some in the outyears, some resources.

MR. ELTAWILA: That's correct.

MR. THADANI: So we could discuss with

Westinghouse and others the key thermalhydraulic issue and the testing issues upfront. So we put some resources for that. If ESBWR or SWR1000 or NG-CANDU come in, the Commission is going to have to make some decisions about how to do allocation of resources.

CHAIRMAN APOSTOLAKIS: But you have to respond if they come in. I mean it's not --

MR. ELTAWILA: That's correct.

MR. THADANI: Yes.

CHAIRMAN APOSTOLAKIS: You can't tell them we can't do it.

MR. THADANI: Well, we can say we can do it, but it seems to me one option would be to get in the line and maybe it will take us longer time because of resource considerations.

CHAIRMAN APOSTOLAKIS: That's the last thing you want to do. I mean --

MR. THADANI: I'm not suggesting that that's what -- it's a Commission decision in the end.

CHAIRMAN APOSTOLAKIS: Right.

MEMBER ROSEN: Is there a problem, to some degree, ameliorated by attempting to do things generically, to set some criteria generically?

MR. KRESS: Oh, yes, that would help tremendously. I think we're off the subject, though.

I mean this is your guy's business, you can figure that out.

CHAIRMAN APOSTOLAKIS: Maybe we can go to the issues at some point. Thank you, Farouk.

MR. ELTAWILA: You're welcome. I think one of the -- well, that's the important issue here, the Commission expectation about enhanced safety, what we mean by enhanced safety.

CHAIRMAN APOSTOLAKIS: Shouldn't we quantify them first, though, the margins, instead of talking about them?

MR. ELTAWILA: That's a very good question.

CHAIRMAN APOSTOLAKIS: Are you going to have it somewhere there to quantify the margins of safety?

MR. ELTAWILA: Not during this presentation. Hopefully, as part of our work, we will be able to try to come up with methodology to quantify the margin of safety.

CHAIRMAN APOSTOLAKIS: Yes. I mean I remember when we were discussing Option 3 here, Mary and your colleagues, what was it, a year ago. They agreed also that that would be something useful to do. In fact, you write it in the report. It's in the report that the margins of safety should be quantified.

MEMBER WALLIS: First of all, you have to --

CHAIRMAN APOSTOLAKIS: Because then you can have the --

MR. THADANI: That's right.

CHAIRMAN APOSTOLAKIS: Sorry?

MR. THADANI: First you need to -- when we talk about some high-level safety principles, it seems to me that they will have to incorporate within them some discussion of what sort of confidence level one is looking at at that level. If one were to define that, then one has to go forward and try and understand what the margins are and what do we really mean by certain level of confidence. And the thinking that we've gone through so far is that is the general path that we're going to have to at least consider and hear options and so on. As to where we end up, I don't know.

CHAIRMAN APOSTOLAKIS: In PRA, what we have really quantified so far is the defense in-depth measures.

MR. THADANI: Yes.

CHAIRMAN APOSTOLAKIS: But we have not

touched the safety margins.

MR. THADANI: Correct.

CHAIRMAN APOSTOLAKIS: We have taken the success criteria, as given to us by the vendor, and then we work with those.

MR. THADANI: That's right.

CHAIRMAN APOSTOLAKIS: Okay?

MR. THADANI: That's right.

MR. KRESS: When the Commission talked about enhanced safety margins for the advanced reactors, I think they had in mind a better safety status. It's not the margins we normally talk about.

MR. THADANI: I wanted to come back to George's point, because one of the things we don't do well -- whoops, I think I turned off something.

MR. KRESS: An SBO.

MR. THADANI: Nice to have some control here. In PRA, George, I guess common uncertainties are sometimes done well.

CHAIRMAN APOSTOLAKIS: Right.

MR. THADANI: But the model uncertainties are not done well at all. And what we're trying to do, and not just in the context of the advanced reactors, but we're trying to make sure that we have efforts underway to try and understand what sort of model uncertainties exist. And one of the issues that I'm exploring, the staff is looking at now, Farouk's staff is looking at, is if we want to modify 50.46 to look for functional reliability of ECCS, I suppose we establish some criteria, ten to the minus X, whatever it is. And we say but you should do realistic analysis, which is good.

Now, let me take you to another event path, if you will. I don't want to assume any systems failing, but I want to understand what things can go wrong in terms of the implicit models in the code. How much confidence do I have in that? Shouldn't there be some relationship of what one might call model uncertainties to establishing some system reliability requirements? And Jack Rosenthal in Farouk's division is going forward to take a look at that.

We're making slow progress, but those are the kinds of things I hope we'll take advantage of as we go forward on these new designs.

MEMBER WALLIS: Ashok, in a totally risk-based world, you wouldn't need margins of safety. I mean they would be inherent in your choice of the risk basis and you might -- you would be able to trade off margin here against margin there --

MR. THADANI: Exactly.

MEMBER WALLIS: -- that the risk basis would give you. And then you would be able to tell the public really that we're assuring a certain level of risk. And how it's done by the industry is up to them.

MEMBER ROSEN: But a totally risk-based world is impossible, because -- in principle, because model uncertainty, things that you don't know about, can't be included.

MEMBER WALLIS: I'm sorry, risk-based regulations can form. Not the world, it's the regulations, they can be risk-based. Then you have to deal with these uncertainties.

CHAIRMAN APOSTOLAKIS: In any case, the issue of margins is right now outside the PRA, essentially. I mean we are really working with the defense in-depth measures and we're quantifying them. If we have redundant systems, we know how to do that. We do this, we do that. We are not including, of course, passive areas, but it would be nice to have all those so we'll be able to make tradeoffs and have a better idea how well we meet the goals.

MEMBER ROSEN: I think some future reactors will have to --

CHAIRMAN APOSTOLAKIS: And these are future reactors.

MEMBER ROSEN: And we'll have to treat passive failures in future reactors in PRA --

CHAIRMAN APOSTOLAKIS: Sure.

MEMBER ROSEN: -- because of the nature of the design.

VICE CHAIRMAN BONACA: Although, I mean for new reactors you have such -- there's a challenge because databases are not available. A lot of information there is not, so there will be very large uncertainties.

CHAIRMAN APOSTOLAKIS: So we've had a long discussion on a slide that Farouk has not even described yet.

(Laughter.)

MR. ELTAWILA: So the Commission has expressed expectation in the advanced reactor policy statement and in the severe accident policy statement, for example, and both of them indicate that they expect the new design to have better margin or better safety than existing reactor.

Just to highlight two points that for the advanced reactor the Commission encouraged the simplified reactor inherently safe and use passive feature, although that's very good but it poses a tremendous challenge to PRA, because now the system is responding to phenomenology rather than a component failure. And we really don't have experience in doing that work so that the passive system reliability becomes an important issue.

CHAIRMAN APOSTOLAKIS: Let me come back to the previous sub-bullet.

MR. ELTAWILA: Okay.

CHAIRMAN APOSTOLAKIS: I guess B, "Safer than current reactors." You have to be very careful with that. And the reason why I'm saying this is several years ago DOE had an office and their highest priority was to build a new production reactor. That was before Mr. Gorbachev came to Washington to meet with Mr. Bush. And DOE being very ambitious, said that our new production reactor will be safer than the commercial reactors. Then when it came time to actually implement that they had a big problem. What does safer mean? Is it supposed to be safer than the best reactor out there? Is it supposed to be safer than the average? What does it mean?

And what was at stake was millions of dollars, okay? Because all it takes is a very progressive utility with an excellent reactor and so on to reach very low levels of core damage frequency, and then the new production reactor had to be safer than that. Okay? And they had the restrictions regarding the sites. One was Savannah River, the other one was somewhere else. Well, you know, the seismic risk was more or less there, so you have to be a little careful when you phrase these things.

MR. ELTAWILA: I agree with you. I'm going to give you my own --

MR. KRESS: That's exactly what he meant by this being a policy issue is what did the Commission mean by statements like that?

MR. THADANI: That's the point here.

CHAIRMAN APOSTOLAKIS: Well, then I'm just elaborating on it.

MR. THADANI: Let me read you something from I think this is the severe accident policy.

CHAIRMAN APOSTOLAKIS: This was a real case, though.

MR. THADANI: As you know, there are three relevant policy statements. One is severe accident policy statement, the other is advanced reactor policy statement and then the standardization policy statement. Those are the relevant policy statements that we're talking about. And I'm just -- let me quote from I think it's the severe accident policy statement. "The Commission fully expects that vendors engaged in designing new standard plants will achieve a higher standard of severe accident safety performance than their previous designs."

And the point here is there is some sort of expectation of improved safety. What does that mean? And that's the same question we asked, Tom was there, of the Commission. We need to be able to articulate what that really means.

MR. KRESS: And the Commission said, "You tell us."

MR. THADANI: Yes.

CHAIRMAN APOSTOLAKIS: Well, usually they would like to see some options, and then they pick around. What I'm saying is there was a real case where people were enthusiastic, it will be safer than the -- and then they had to eat their words. They just couldn't afford to be safer.

MR. ELTAWILA: As a minimum, provide the same degree of protection as current plants, and I think that's the second part. And I really think the issue of safer, and that's my own interpretation, is that there were a lot of uncertainties in the severe accident at that time and the expectation that by resolving this severe accident issue you will be able to understand them better and you can make a better safety case.

MR. KRESS: They can provide a higher level of confidence in your review of your safety.

MEMBER POWERS: When we started looking at probablistic approaches to, "Oh, we want to make plants safe," we very quickly realized that if you look at prevention systems, you can only go so far with them. Eventually, you get to the point where having redundancy and even diversity in systems actually starts costing you safety rather than helping. And so you had to have what has come to be called a balance between prevention and mitigation. And that became pretty much a pretty good guide for what we were trying to do in the area of safety.

Now we see people coming forward with more advanced reactors, and one that comes immediately to mind are the AP series of reactors. What you're saying, "Gee, we've done this PRA analysis on this thing, and our prevention systems are tremendous and they give us CDFs of ten to the minus seventh and things like that." And, you know, how do we react to that?

You can look at their probablistic risk

assessment, and if it's like most probablistic risk assessments, there are things you can quibble on, but you don't find things that say that this absolutely wrong, that the prevention systems just aren't this good. But, quite frankly, you don't believe it. And so do we still have to -- I mean do we have to evolve this concept of a balance between prevention and mitigation or are we just changing the balance between prevention and mitigation? Where do you see this going here?

MR. ELTAWILA: Again, that's one of the policy issues that we are asking the Commission, and I think I'm -- how about if we wait until we get to that issue and see the question that we're asking are the right questions and we'll see where we develop the technical basis for that.

MR. KRESS: I'd like to point out on the third bullet to the Committee that these guys have been listening to us. You could probably find every one of those in one of our letters or another.

CHAIRMAN APOSTOLAKIS: What does RIRIP mean, risk-informed rest in peace?

(Laughter.)

MR. ELTAWILA: That's exactly what it is. That's Commission definition of that.

VICE CHAIRMAN BONACA: On the question of should a higher level require that, I think simply by placing some requirements for containment for severe accidents from the current generation, you would already, in a qualitative sense, set up a higher level of expectation in safety. Right now we see everything which is severe accidents beyond design basis to make some portions of that part of design basis.

MR. THADANI: I think it's useful to touch Dana's point, it seems to me. AP-600, for example. I mean we had a clear path, clear guidance from the Commission as Part 52 of our regulations, and then referring to Part 50; that is, you meet our regulations, that you address all unresolved safety issues and high- and medium-priority generic safety issues, that you conduct a PRA and if it identifies areas for enhancement, you conceded those.

And then we went beyond and we looked at their words about reliability of decay heat, both in the context of core damage and containment response. And we looked at some challenges to containment, particularly early challenges, to see what sort of features could be added to significantly reduce those threats. And there's no question, at least in my -- well, in addition to that, obviously, the rule says they need to meet our safety goals also.

Now, one can always use that approach, but is that the most efficient way for new designs? And my own sense is that there is a better way to go at it. But it needs to be borne out through some real work, and we're just at the beginning of that.

MEMBER POWERS: I mean your first policy issue hints at the problem. We can go ahead and say, meet the safety goals and they'll have exactly the same problem the current plants have, and it's very difficult to tell whether you are or not, so you end up using a surrogate. And you raise that question of the current metrics, and I've seen a lot of people raising that question, and for the life of me it puzzles me. Because I look at CDF, core damage frequency, and I say, well, some of these reactors don't undergo core damage the way I look at core damage, but I sure as hell know what a core damage event in them is as much as I do one in a zircalloy clad oxide fuel one. I mean it didn't strike me as a tremendous leap of imagination has to be gotten to change that CDF into -- I mean you're just changing the letters a little bit, but then number's about exactly the same.

MR. THADANI: I think the point here is

more than just the CDF itself. Do we want to stay with the same value of LERF that we've been using? Do we want to stay with the statements we made for AP-600 and others, 24-hour containment integrity for those certain threats? Is that what we want to stay with?

MEMBER POWERS: Yes. Now, that's -- those are real questions, because --

MR. THADANI: Yes. And those are the things we're talking about.

MEMBER POWERS: And the containment versus confinement debate comes up.

MR. THADANI: Yes.

MEMBER POWERS: And, you know, some of the words I've seen on that have been interesting to me, and I'd just point out that the Savannah River reactors were designed with confinements, and those confinements, when we think about confinements and terrorist or sabotage acts, sometimes we think they're orthoginal with those confinements, were designed to take an airburst from a nuclear weapon. So you can design a confinement to be perfectly robust. It's just a different approach than a containment, and --

CHAIRMAN APOSTOLAKIS: Also, it seems to me the words, "prevention" and "mitigation" refer to a particular point, in this case, CDF, I mean core damage. You want to prevent it, and then if it happens, you want to mitigate the consequences. What if you don't have a core damage pivotal event, but you now have a frequency consequence, I mean release curve? Again, it's not obvious to me what prevention and mitigation means in that case because you will have different frequency regions.

MEMBER POWERS: Well, I think, George -- I think -- when I said it didn't take a big leap for me to translate CDF to something applicable to, say, a coded particle fuel reactor in a large graphite block, it seems to me that the only thing that counts is when you release fission products.

CHAIRMAN APOSTOLAKIS: Yes.

MEMBER POWERS: If the only thing we did was damage core, we wouldn't care. And, of course, that's one of the great attractions, the molton salt reactor. You could probably the damage the core a lot and not release any fission products at all, because they'd absorb into the molten salt.

And when you look at frequency consequence curves, I mean, yes, in reality, they're nice, smooth curves and whatnot, but they have a sharp cliff, and when you go over that cliff you know that that's different than when you're just slowly degrading down.

CHAIRMAN APOSTOLAKIS: And also it depends on where you're releasing. It could be outside, could be somewhere inside.

MEMBER POWERS: But it only counts if it gets to the great out outdoors.

CHAIRMAN APOSTOLAKIS: If it isn't outdoors, it doesn't matter.

MR. THADANI: But that is not the point. I think we're going to have to think this through to balance and design. I think that's -- I believe you said that, and let me use an example: Reactor pressure vessel today. We want to be sure, have pretty high confidence that it's very, very unlikely that you'll fail reactor pressure vessel. What are potential challenges to the integrity of the pressure vessel? Should you somehow divide the balance and design? Does that mean that you have frequency of challenge and the conditional probability of vessel failure? Do you have to build that in in the vessel to get balance because you're trying now kind of two different things.

MR. KRESS: Sure, you're allocating among sequences, and I think you --

MR. THADANI: That's why I think frequency consequence --

MR. KRESS: Yes, yes.

MR. THADANI: -- you still have to think about other factors.

MR. KRESS: You do, but I think this question of prevention versus mitigation has to be rethought. In the first place, we don't have any guidelines on what that balance ought to be. If you look at the current plants, you get some conditional containment failure probabilities of 0.8. That's like not having a containment at all. And then, by the other token, you get some down around 0.01. So we don't have good guidance on what that ought to be, and in my view, some of the concepts, the molten salt, for example, or the tri-cell coated fuel particle taps do both their prevention and mitigation in one concept. And I think that ought to be a way to think about it.

And I really think the overall view ought to be do we meet high-level risk acceptance criteria at a sufficient level of confidence? And the way you build defense in-depth in that, in my mind, is to talk about the uncertainties, and what you want to do is balance that uncertainty across all these frequency ranges.

CHAIRMAN APOSTOLAKIS: But the uncertainty --

MEMBER POWERS: The problem I've always had with that, you know, "Let's talk about the uncertainties," is that's great but you guys won't. The only uncertainties that ever get discussed -- usually uncertainties aren't discussed at all. All we get is point estimates, even from you guys, Ashok. Today we didn't.

MR. THADANI: I accept the criticism.

MEMBER POWERS: But when we do get uncertainties, all we get these mamby-pamby little various -- this adhesion coefficient or something like, nobody coming in and asking really where the uncertainty is and whatnot. And so whereas you're right, perhaps, though I don't actually agree with you, but I will concede you have a point in principle, I think in practical fact it can't be done. And you're forced to come where I'm much more comfortable is saying, what if the codes and analyses are wrong? And that's where you start addressing defense in-depth.

CHAIRMAN APOSTOLAKIS: And margins, I think, not just defense in-depth. They go together, although defense in-depth is the first thing that comes to mind.

MR. KRESS: My view is --

MEMBER POWERS: I won't argue with you on that.

MR. KRESS: My view, Dana, is that the uncertainties are a measure of how wrong the codes are if you could quantify them.

MEMBER POWERS: It's a measure that you never make.

MR. KRESS: Yes. We ought to be able to do it better.

CHAIRMAN APOSTOLAKIS: No, but you see I think what happens --

MEMBER WALLIS: If you haven't made up to now, it's going to be made.

CHAIRMAN APOSTOLAKIS: But what's going to happen, guys, is the typical thing that engineers and scientists do. Even if they try to quantify them, they will quantify the uncertainties in the hardware, in the processes, perhaps, and so on. I'm willing to bet that nobody will come here and say, "And if we build this reactor and we have these regulations, the licensee will ignore this particular program and that will lead to all sorts of problems," because we don't think that way, and yet that's a major uncertainty.

MEMBER POWERS: Well, I mean what are the chances we're going to build one and say, "And I bet you this guy let's the boric acid chew through the head."

CHAIRMAN APOSTOLAKIS: Well, that's what I meant, that we heard today that the inspection program -- that was a conclusion of the root cause analysis -- was good enough. It's just that it was not implemented right, and the AIT report concludes the same thing. That's its first conclusion, in fact. They said it was pretty good, but if you don't have the -- now, do you design the reactor with that kind of uncertainty in mind? I doubt it very much; I don't think anyone would do that.

MEMBER WALLIS: You have the same thing with codes, and we know that when we say thermalhydraulic code, different people get different answers depending on how they use it. So you've got the human factor there too, someone who's careless use of a code, predicts something which is really not a good answer and then uses it is just as careless as the guy who let's boric acid sit --

MR. KRESS: We design reactors now with our general design criteria and our design basis accidents, and we take account of that by talking about single failure criteria, but we don't deal with it in there. Where we deal that is in the other parts of the regulations having to do with the reactor oversight, inspection. I don't see a reason why we have to change those parts of the regulations. I think what we're dealing with here is trying to design a regulatory system that helps a reactor design get certified in the first place. And then these other issues I can deal with them in other parts of regulatory space.

CHAIRMAN APOSTOLAKIS: Maybe you want to use different words there that will be safe enough.

MR. KRESS: Oh, safe enough, yes.

CHAIRMAN APOSTOLAKIS: And also realistic. You know, it pains me to admit this, but I think there is some point to the structure of this interpretation of Defense in-depth, because people are wrong. I thought it was a joke but people do make mistakes.

MEMBER POWERS: Not at MIT.

CHAIRMAN APOSTOLAKIS: Well, but we don't design them, unfortunately.

The second conclusion of the AIT report was tat a BNW owner's group underestimated the rate of corrosion by at least a factor of two. Now who would have said that in a study, in a PRA, that they will do these calculations but they may also be wrong with some probability? You can't say that. First of all, people will be all over you. But it's something that's inconceivable, and yet people do do those things.

MEMBER WALLIS: You figure that in. Certainly, I use the code example. I mean you know something about the accuracy or uncertainty in the predictions of codes, and you do build it in.

CHAIRMAN APOSTOLAKIS: See, that's the thing --

MEMBER WALLIS: But it's not formulated in a quantitative way. You certainly bring it into your consideration when you're making a decision, but it's not formulated. What you're asking for is some quantitative measure.

CHAIRMAN APOSTOLAKIS: Well, I'm not asking for it. I think it's some uncertainty that we don't even think of.

MR. KRESS: Anyway, I think this --

CHAIRMAN APOSTOLAKIS: Make the system more robust because you never know what's going to happen, that kind of thing.

MR. KRESS: I think this discussion points out a lot of formidable challenges these guys have.

MR. ELTAWILA: Mr. Chairman, I'm less than one-third of my presentation, and I have 15 minutes.

No, I need guidance. There is no way I can go through the whole -- are you allowing me time or you want me to finish at certain time?

CHAIRMAN APOSTOLAKIS: Use your judgment and skip some things.

MR. ELTAWILA: I will skip something, but I'd really like to highlight here on that viewgraph is that the Commission had expectation that new reactor will have containment equivalent to large, dry containment. Of course, they meant light water reactor. They did not mean at that time gas core reactor. And the basis for that they approved a confinement versus a containment in the policy paper. So I'm bringing it upfront here.

Some of the policy issues that Mary's going to address in her Commission paper are should we be looking at different cornerstones in our regulatory framework? For example, radiation protection for worker, security and safeguards. These are a couple of the issues. Should we be considering lead contamination as part of our -- the metrics of the --

MEMBER POWERS: Cornerstone issue. I could imagine that you might have well to enhance your safety and security just because of the current environment, but let me ask you, do you think that you're getting enough mileage out of the known risk-informed cornerstones that you have, that you need to look for others of those? You know, radiation protection, health security, things like that. I mean they're the stepchildren of the cornerstones as it is. Do you need more stepchildren?

MR. ELTAWILA: No, but that's all. The Commission said no before, yes?

MEMBER POWERS: It seems to me I would not waste a lot of time on that. The lane contamination really is something that they need to decide, but I think we know what the answer is going to be.

MR. ELTAWILA: Yes. I think the issue of defense in-depth I think Tom alluded to it. When you have the tri-cell particle that performs both the function of prevention and mitigation and the fuel can't stand very high temperature for a long period of time, assume this is true. Can we allow the length of time as a barrier, as a defense in-depth. These are some of the questions that we'll be tackling in the future.

MEMBER ROSEN: Well, before you get off that slide, there's one I -- the Generation 4 Program has pointed at that's not there, and that is the need for off-site evacuation.

MR. ELTAWILA: It's in there.

MR. THADANI: It's coming.

MR. ELTAWILA: These additional policy issues -- I'm going to address the emergency planning as part of this.

CHAIRMAN APOSTOLAKIS: But these are related also to the others. If you bring up the issue of international standards, for example.

MR. ELTAWILA: Quickly, since these designs, or most of them, are done overseas, we really need to look at the senders overseas and see if we can capitalize --

CHAIRMAN APOSTOLAKIS: Yes, but for example, the Europeans don't really have safety goals; we do. So I don't know how you --

MR. THADANI: Well, I think if you go back and let me use EPR. If you go back and look at the EPR safety principles, they include probablistic considerations.

CHAIRMAN APOSTOLAKIS: Not the way that our Commission has -- I don't think they say this is a goal, do they?

MR. THADANI: Well, they establish some probablistic considerations --

CHAIRMAN APOSTOLAKIS: For what?

MR. THADANI: -- which then drive them to certain designs, for example, in terms of core damage severe accidents.

CHAIRMAN APOSTOLAKIS: But we have it at --

MR. THADANI: Ten to the minus X they have.

CHAIRMAN APOSTOLAKIS: Yes, but we have it at a level of individual risk.

MR. THADANI: Oh, yes, yes, they don't.

CHAIRMAN APOSTOLAKIS: They don't do that.

MR. THADANI: You're right. You're right.

MR. KRESS: With respect to this, Ashok, Farouk, I may be a maverick on this issue because I think it be well to understand what the safety requirements are in other countries and IAEA, their principles and stuff like that. But I find it perfectly reasonably to say different countries that have different have high-level risk acceptance criteria. That's because they have different citing characteristics, they have different values. They might value nuclear more than we do because it's the only option they have. So it's perfectly reasonable to me that we'd have a different set of safety standards than some of the countries.

CHAIRMAN APOSTOLAKIS: At the health and safety level, yes, but the core damage or equivalent level, I'm not sure that's a wise way to go. Because one accident somewhere kills everybody.

MR. KRESS: Well, I don't think that's necessarily true either. I think that's a misnomer.

CHAIRMAN APOSTOLAKIS: I think we've used the argument that that design is different from ours to the limit. I don't think the American people will buy that.

MR. THADANI: I think that there's so many different variables that I think there are different forces that would push certainly western Europe in some directions that we may not want to go.

MR. KRESS: That's exactly my point. I don't think it's true that an accident anywhere is an accident everywhere, especially for some of the new plants.

CHAIRMAN APOSTOLAKIS: I think you're going to have a hard time convincing me --

MR. KRESS: Only philosophically.

MEMBER POWERS: But from a practical point of view, I think you're right, Tom, that we had a major accident in Russia with a plant design that was very different from ours. And it had a remarkably little impact on the United States nuclear power program. Big impact on Europe's but remarkably little in Japan. So I think, yes, once the designs are distinct enough, you're probably right.

CHAIRMAN APOSTOLAKIS: But my argument is that -- the argument that the designs were distinct enough was accepted last time. I'm not sure how many times the American people will accept that.

MR. KRESS: They also didn't look very close either.

(Laughter.)

MEMBER SIEBER; A more important factor may have been the fact that they're far removed from us and people, when something happens thousands of miles away, don't see it as --

CHAIRMAN APOSTOLAKIS: I really don't want anybody to have a reactor with a core damage frequency of ten to the minus three or two. I don't care where it is, I don't care what their needs are.

MEMBER POWERS: There are a couple of them.

CHAIRMAN APOSTOLAKIS: They should --

MEMBER POWERS: Already.

CHAIRMAN APOSTOLAKIS: The West is doing something about the ones I know about.

MEMBER POWERS: They would try to bomb them.

CHAIRMAN APOSTOLAKIS: Okay, Farouk.

MR. ELTAWILA: The first policy issue that we are putting in front of the Commission is the event selection and safety classification of system structure and the component. And as I mentioned earlier, that this passive system the traditional PRA will not work the same way --

CHAIRMAN APOSTOLAKIS: What do you mean by better selection? You mean design basis?

MR. ELTAWILA: Yes, the design basis and beyond design basis. So these are the -- yes, design basis selection. And the selection of these, for example, they will be generally low probability event, but they are going to be responding to different uncertainty. So assessing the reliability of this system and try to quantify the core damage frequency or LERF based on these phenomenological uncertainty will be extremely difficult. So sheds doubts about the usability of PRE.

That issue was raised in front of the Commission long time ago and in the 1993, and the staff at the time said that we are going to use a blend of deterministic and probablistic approach.

We'll use the deterministic as it exists right now and supplement it with risk information. And the Commission found that to be acceptable at that time.

CHAIRMAN APOSTOLAKIS: Well, that was nine years ago, but I would say -- well, first of all, is your -- does your second bullet imply that maybe we will not have design basis accidents at all, that we'll have some other approach that maybe some people can come up with or a test to -- we have to have them? Maybe not in the --

MR. ELTAWILA: The approach that was proposed by the PBMR have some design basis approach, but, again, they are selected using PRA.

CHAIRMAN APOSTOLAKIS: Right.

MR. ELTAWILA: You know, that they were not really deterministic. They said that these are the design requirement that we are going to design the plants for.

CHAIRMAN APOSTOLAKIS: Because there is value to having specific accidents and accident sequences, because then it eases communication. There's no question about it. At the same time, you may not want to treat them the way what is in the LWRs.

MR. THADANI: If you go, for example, the concept of frequency and consequences, if you go to that concept, consequences starting with nothing happening all the way to some significant releases, if you go to that, the point here would be you can do that in absence of a specific design, you can lay out some things. But then when you go to the specific design, you still need to -- maybe using that concept, you still need to, as you were saying in terms of communication, analysis and so on, need to identify what are those events that you need to --

MR. KRESS: You have a copy of my viewgraph that I gave to the Commission?

CHAIRMAN APOSTOLAKIS: Yes. I don't like the word, "supplemented," excuse me.

MEMBER WALLIS: I don't see how you can set deterministic requirements for a reactor concept which doesn't yet exist. You can always set probablistic sort of requirements and safety goals, but you cannot set deterministic goals.

MR. KRESS: I was proposing an iterative process in my slides to the Commission in which you have some sort of -- you always are going to have a design concept. You don't have anything unless you start out with a design concept. And you can select initiating events for those concepts, and you can establish some sort of initiating event frequency. Now, that's going to be the tough part, but the question is now which of these events and at what frequency level are you going to cut off and say these are design basis and these others aren't? Well, you could do it iteratively in the way that I proposed, and you would have to adjust the design, but you have to have a PRA to do this.

MEMBER WALLIS: That's right. You'll be --

MR. KRESS: And you have uncertainties in it, and you have to have high-level acceptance criteria.

MEMBER POWERS: Tom, the difficulty I have is that's great if I'm designing the reactor. But when I'm in the business of regulating the reactor, and you've gone through all that, do I care?

MR. KRESS: Once the design is fixed, that's the basis for certification.

MEMBER POWERS: No, no, no. Why should I care? Why shouldn't I say the basis of certification is this plant has an expectation value of the risk of such and such a value at such and such a confidence limit, and I really don't care what particular accidents the designer worked to try to knock down at very low levels?

MR. THADANI: If you take that in conjunction with other requirements like, for example, source term, containment fuel, quality and things like that, you can make that determination.

MEMBER POWERS: Yes.

MR. KRESS: Dana, I think this is back to my rationalist defense in-depth concept, and what it has to do with is you focus on individual sequences, and this is a way to do it. And you assure yourself that individual sequences meet two criteria: One, they don't contribute overly to the overall risk, and they don't contribute a huge amount to the uncertainty. That's why you do it in that manner.

MEMBER POWERS: Well, we've debated this before. I mean I don't care if my risk is ten to the minus eight and it's 99.9 percent due to one sequence, that's fine with me.

MR. KRESS: Yes. But you wouldn't want 99 percent of your uncertainty be due to that sequence. That's my point.

MEMBER POWERS: If the uncertainty is only ten percent, I don't care.

MR. KRESS: Well, that's true too. That's a sliding scale.

MR. ELTAWILA: The Commission actually addressed part of that issue in the '90s. For example, the air intrusion that was very low probability event, but the Commission said, "Don't have arbitrarily cut off at the exact frequency." Consider that issue, even though it's a very low probability, look at the consequence in that issue --

CHAIRMAN APOSTOLAKIS: Right.

MR. ELTAWILA: -- and incorporate it in the --

CHAIRMAN APOSTOLAKIS: The PRA.

MR. ELTAWILA: -- in your decision.

MR. KRESS: You have to look at all sequences.

VICE CHAIRMAN BONACA: In Option 2 right now we're struggling with the issue of having just one criterion, okay, to throw things into Risk 1, 2, 3 and 4, and we have in fact discussed the possibility of having -- well, the FSAR has different criteria, has a set of criteria, generally. What are we going to use here? Are we going to intermediate criteria for the --

CHAIRMAN APOSTOLAKIS: I think it's covered by his earlier comment that -- what was it?

MR. THADANI: It was the issue of

classification.

CHAIRMAN APOSTOLAKIS: The cornerstones, additional cornerstones. You may want to add additional. But I really don't like the word, "supplemented,"

VICE CHAIRMAN BONACA: But I think certainly we don't want to get into a situation, as we have right now, for Option 2 where --

MEMBER POWERS: I mean "supplemented" is what they said.

MR. ELTAWILA: That's what the Commission said. I think what we responded to Exelon we indicated there's going to be a blend of both real deterministic and probablistic analysis.

CHAIRMAN APOSTOLAKIS: Okay. That was in 1993, wasn't it?

MR. ELTAWILA: Yes. It's just a statement.

CHAIRMAN APOSTOLAKIS: I think from the whole discussion here in my view there will have to be deterministic requirements at least for the ease of communication, but these should be based on probablistic arguments as much as possible.

MEMBER POWERS: George, we're all Bayesians now.

(Laughter.)

CHAIRMAN APOSTOLAKIS: It's not this Committee that worries me.

MR. ELTAWILA: With probablistic arguments, with the robust consideration of uncertainties.

MEMBER POWERS: Yes, I'd like to see that happen.

MR. KRESS: That's our mantra now.

MR. THADANI: But you know, you've got to keep pushing. I think we cannot --

CHAIRMAN APOSTOLAKIS: But, you know, Ashok, it's very disappointing what's happening in real life. I mean the reactor safety study 25, 27 years ago quantified parameter uncertainties. We ought to be discussing now model uncertainties. And what's happening? People are not even doing the parameters anymore. It's really very discouraging.

MR. THADANI: I know Mary's just itching to get and react to that statement, but I can tell you that there's really a fair amount of effort -- let me make sure. Maybe we have not been here talking to you as to what it is we're doing to move in that direction. I think your observation is reasonable that I've seen more studies recently over the last few years which have had less discussion of uncertainty than I used to see many years ago.

CHAIRMAN APOSTOLAKIS: That's right.

MR. THADANI: So I think that --

CHAIRMAN APOSTOLAKIS: And you know why? I've talked to industry about these things. You know what the answer is? The NRC staff doesn't want them. I'm sorry, but that's what they told me: Why should we do it? Anyway, let's go on.

MR. ELTAWILA: The issue of fuel performance and qualification is one of the most important issues, and I think the policy decision that we would be seeking guidance from the Commission is regarding the test requirement. You know, we traditionally stopped at design basis requirements, so what is the role of beyond design basis? Should we stop -- they can demonstrate that the fuel will keep the temperature of 1600 degrees. We would like to require additional test that will go beyond that and look at the failure point and so on and when you can release the fission product.

MEMBER WALLIS: This is a deterministic thing which is thrown out in the air. It depends upon what the fuel is, what the accidents are, what the risks are. You can't just pick a number like 1600 degrees C.

MR. ELTAWILA: I did not pick that number.

MEMBER WALLIS: But you can't.

MR. ELTAWILA: I think because they have qualifications --

MEMBER WALLIS: You put it down there. Someone --

MEMBER POWERS: I think Graham is raising a general point here, and not just the fuel, but the general point is that why wouldn't you treat this just the way you treat many of the things now in looking at a safety analysis report? A guy has come to you and he's said, "Gee, I've got a reactor here. It's ten to the minus eighth reactor, and I proved it with this analyses." And you go through that analysis and you say, "Okay, one of your assumptions is that the fuel is good to 1600. It doesn't even hint at releasing fission products at 1600 for three and a half days. Prove that to me with test data and things like that." And you would just go through other things but following the assumptions that he made when he had done his analysis of the risk. I mean why focus just on fuel? I mean it would be all of the major assumptions. It may be up to some discretion and guidance from the staff on which ones they wanted to go after.

MR. ELTAWILA: Again, Dana, because as I indicated earlier, that the decision on any of these issues will affect the other decisions. So if you are going to say that there will be no fission product released ever, then you want to be sure that this decision is not at 1650. You're going to start seeing a release in fission product.

MEMBER POWERS: Everything comes out.

MR. ELTAWILA: So it's again because the importance that was given to the fuel as a prevention and mitigated feature that you want to have more assurance that we have done in the traditional fuel design.

MEMBER SIEBER; Okay. I guess when I see you said the burnups and temperature requirements in a deterministic way, you're really putting a box around what the fuel cycle will look like, which sets the cost.

MR. ELTAWILA: I apologize. This was Exelon proposal. I should have made that clear. This is the proposal that will be running at 80,000 megawatt day per metric ton and is going to be with a stand temperature of 1600 degrees C. That's not our requirement.

MEMBER SIEBER; Okay. I don't think we ever should make a requirement like that.

MR. KRESS: This may be an issue specific to gas cool reactors.

MEMBER ROSEN: Right. But I'm known to think about these things generically. Should you qualify for fuel's performance? Absolutely, but it may be different for different designs. Should fuel qualification testing be completed prior to granting a mine operating license? Excuse me? I wish we would just all rise at once and say, "Of course." I mean we didn't do that before but that was then, this is now.

MR. KRESS: Wait a minute. Suppose I told you that I have a fuel that I can't qualify?

MEMBER ROSEN: Well, I'd say you have a problem convincing me to license your reactor.

MR. ELTAWILA: What would you say that we have a fuel that was produced based on the same manufacture and process, like in Germany, but even you cannot prove to anybody that you are going to be following that process?

MR. KRESS: That's exactly --

MR. ELTAWILA: And there is a qualification, there are wealth of database on the Germany fuel, but the technology itself they have not produced that fuel using this process for a long period of time. So can you rely on this old data or you want the current processing of the fuel be tested to prove that this condition will be attained?

MEMBER POWERS: It's a cute question because you know what the answer is. They're not even close to reproducing the German fuel. I mean it's appalling how far away they are.

MR. KRESS: And not only --

CHAIRMAN APOSTOLAKIS: Just have the Germans do it then, make it?

MR. KRESS: But not only that if they do get the process down to where they've got the same quality fuel, and then you're going to take so many billion of those things and stick it in your reactor, to say that each one of those now has that quality based on the fact that I know how they made it, there's no way, in my mind, you can statistically prove that fuel has the quality that they said it has. And that's your issue here. You have to focus on process rather than product.

MEMBER POWERS: Well, don't worry, Tom, they're so far away now they can statistically prove they ain't there.

MR. KRESS: Well, right now, but they can prove they're not there, but when they want to hit their target level they can't prove it. But I suggest that it's because you can't stick enough of this fuel and take it to that burnup level, at that temperature long enough in a test reactor, there's no way you can get the statistics out of that. What you have to do is test all the fuel at the same time.

MEMBER POWERS: And what's --

MR. KRESS: And the only way to do that is stick it in your reactor and, as installed, during startup and initial operations, you look to see how much fission products you get in your primary system. This should be a measure of at least how many faulty fuel elements you have. It's just like -- you know, we measure the quality of the fuel now by looking at how much activity is in the thing. You're going to have to develop that kind of concept for these, I think. And it ought to be part of the licensing provision.

CHAIRMAN APOSTOLAKIS: Isn't it completely inconceivable that I can have some damage to the fuel but then I have other means to contain it?

MEMBER SIEBER; Yes.

CHAIRMAN APOSTOLAKIS: Why?

MEMBER SIEBER; We usually put a reactor

pressure vessel around it.

CHAIRMAN APOSTOLAKIS: So then why do I need -- I mean I can provide other measures. Contain, let them clean it up.

MR. KRESS: Well, you can, you can.

MEMBER POWERS: We kind of do that right now.

CHAIRMAN APOSTOLAKIS: So, again, we're going back to the picture of the reactor as a whole, of the plant. It's not just --

MEMBER SIEBER; You've essentially removed one of the barriers of your risk --

CHAIRMAN APOSTOLAKIS: But I may have installed another one.

MEMBER SIEBER; Yes. You may just put more and more barriers.

MEMBER POWERS: Well, you're right, George, in the sense that we have much the same problem that we were discussing in connection with Yucca Mountain. We all agree that there are going to be multiple barriers. Now, the question is do we put our constraint on what the totality of those barriers are? Or do we go in and say, "Okay. The totality has to be hits," but no one barrier can be more than 30 percent of this.

CHAIRMAN APOSTOLAKIS: Absolutely, absolutely.

MEMBER POWERS: And that's a very interesting question to get into, and every time I persuade myself that I don't want to dictate what the barriers do, you come back with an argument on why I should.

CHAIRMAN APOSTOLAKIS: Farouk, you are going too slow here.

(Laughter.)

MR. ELTAWILA: I'll try. Okay. The issue of the source term is one of the -- traditionally, we use the TID 14844 or NUREG 1465 as a generic source term. The pebble bed and all advanced reactors try now to have a scenario-specific source term. And that I raise a question about the experimental database to support that, the fission product release and transport and the models and so on. We raised that issue in front of the Commission in '93, and they found there is no problem in using a mechanistic source term for the specific scenario, provided the database is adequate to address that issue. And as a matter of fact, in that regard, they said that we should be including their intrusion scenario.

The next issue is the containment

performance issue. I'm sorry?

CHAIRMAN APOSTOLAKIS: We discussed this already. Didn't we discuss this?

MR. ELTAWILA: I'm sorry.

CHAIRMAN APOSTOLAKIS: I thought we discussed most of this.

MR. ELTAWILA: That's true and so we can move on. Same issue with the --

MEMBER POWERS: Well, I think for our discussion purposes, sometime, just between us girls here, we're going to have to come down to some agreement on how we're going to handle the sabotage versus the more classical thing. Are we going to just set that aside and say we'll deal with sabotage and terrorist threats aside or are we going to continue to mesh is together? Because it really causes confusion, in my mind.

MR. ELTAWILA: It is an issue that --

MEMBER POWERS: I mean in the end you're going to have integrate it all together, but for discussions purposes --

MR. ELTAWILA: Yes. It is an issue that we're going to have to address, period.

MR. KRESS: That's another reason to change our thinking on the balance between prevention and mitigation. I think the more you put on the front end the less vulnerable it is to sabotage. That's a personal opinion. I think that, for instance, a pebble bed reactor is probably much less vulnerable to sabotage than an LWR.

MEMBER POWERS: Oh, I think it's much more.

MR. KRESS: Well, we'll have to debate it.

CHAIRMAN APOSTOLAKIS: Emergency.

MR. ELTAWILA: The next issue, Mr. Rosen, is the emergency evacuation, and the issue was addressed again in 1993 about reducing the EPZ and looking for it based on the small source term and so on. And the Commission at that time did not feel that we had enough information to reduce the EPZ, but at the same time told the staff to keep an open mind about this issue and come to us when you have additional information. We are keeping an open mind about this issue, and we're going to address it in totality with the rest of the other issues as part of the --

CHAIRMAN APOSTOLAKIS: Which may lead to an increase in EPZ --

MEMBER POWERS: Well, especially when you have --

CHAIRMAN APOSTOLAKIS: -- depending on the reactor design, right? It's part now of the total risk profile.

MEMBER POWERS: I think you've got another thing to take into account. You've got a societal thing to take into account.

CHAIRMAN APOSTOLAKIS: That's exactly right.

MEMBER POWERS: Because you've got a bill in Congress right now that says make the EPZs 20 miles.

MR. THADANI: Well, I don't think the bill says to make EPZ 20 miles. I think it talks about KI.

MR. KRESS: Yes. It's a planning and --

CHAIRMAN APOSTOLAKIS: But I don't think we should focus our discussion on reducing the EPZ. I think everything else we have discussed today is that we should look at the system as a whole --

MR. ELTAWILA: We should look at the whole thing as in development.

CHAIRMAN APOSTOLAKIS: If meeting the safety goals requires a larger EPZ, so be it.

MEMBER ROSEN: Right, but nobody's designing new reactors with a goal of having a much larger EPZ.

CHAIRMAN APOSTOLAKIS: That's their business. We are regulators.

MEMBER ROSEN: The business end of the business is attempting to provide an attractive product, and one of the most attractive products is one where you can put a reactor someplace and say, "See," to the public, "this reactor is so safe we don't even have an off-site emergency plan."

MEMBER POWERS: But you can say that -- I mean I could say that right now. You've got to persuade the public that they agree with you.

CHAIRMAN APOSTOLAKIS: Yes.

MEMBER ROSEN: Because the next sentence is not that it's so safe that -- you don't stop with, "It's so safe that we don't need an off-site emergency evacuation plan." You say that, and you say, "Because," and then you give a cogent answer that people can understand.

MEMBER POWERS: I think I would believe you more if you said, "It's so safe that we don't need an EPZ, and it's so safe that we don't even want Price-Anderson indemnification."

CHAIRMAN APOSTOLAKIS: All we need today is a process for determining these things. We don't have to convince anybody. We have to convince people that our process is rationale and science-based. That's all.

MR. KRESS: Clearly, if you had high-level risk acceptance criteria and had appropriate PRA with uncertainties that showed that at particular confidence level you meet those without any emergency response at all, the question I would raise is that would be a nice goal to have but wouldn't you want an emergency plan anyway, even though you had that?

MEMBER POWERS: That's right, because you might be wrong.

MR. KRESS: Because I might be wrong. And there might be other considerations, like sabotage and things like that.

MR. THADANI: The Commission has -- we've had some requests, as you know, to reduce EPZ in some cases. I guess when EPRI came to us in the requirements development, ALWR document, that was one of the issues. They wanted to reduce the EPZ. And, basically, what we told them then, and I recognize this is several years ago, what we said was that emergency planning is considered yet another layer of defense in-depth outside of the design considerations. But as I think George was saying, these are all linked issues, and come out where it does and the Commission

-- we just need make sure we give Commission the relevant information.

VICE CHAIRMAN BONACA: Okay. That's it. Thank you.

MEMBER POWERS: The plan is that Mary is going to be the lead author on this document?

MR. ELTAWILA: I'm sorry?

MEMBER POWERS: May Drouin is going to be the lead author on this document?

MR. ELTAWILA: Which document? The policy paper is Tom King. And Mary has the policy paper --

MEMBER WALLIS: Tom King?

MR. ELTAWILA: Yes. He's --

MEMBER POWERS: You remember him.

MR. ELTAWILA: -- back.

MEMBER WALLIS: I have a comment on this whole thing.

MR. KRESS: We'll open the floor for comments at this point.

MEMBER WALLIS: What I see here is a whole series of questions, and I see very little in the way of confidence that you guys have the answers.

MR. ELTAWILA: We don't.

MEMBER WALLIS: The ACRS has been sitting here trying to get some answers, but that's just our game. I mean it's your job to come up with answers.

MR. KRESS: Their job right now is to define what the questions are.

MEMBER WALLIS: So I have a lot of doubt about you meeting anything like a deadline by fall 2002.

MR. ELTAWILA: No. I think maybe we present you with the same Commission -- the same question that we asked in 1993. There was a decision taken by the Commission. The staff made the recommendation to the Commission. So we know the answers to most of these questions. All what we are doing right now revisiting this question to see if we are changing our mind because of information that we have or because of new policy change or something like that. But I think we feel very confident that all these questions will be addressed satisfactory by the --

MEMBER WALLIS: So all the questions have been answered before and you're just tweaking the answers? Is that what you're doing?

MR. ELTAWILA: Well, I don't think it's tweaking the answers. It's just looking at the additional information that we have, the experience that we gained in risk-informed regulation and see if it changed any of these answers.

MR. THADANI: I think -- let me be careful because I want to make sure we're not missing each other's point here. What we're talking about is a set of issues. As you know, some of the technical issues it's going to take a long time before we get real information. But we want to make sure that the course of action that we lay out for us to follow is agreed to. I mean we're not going to be able to have risk-informed regulatory structure in three months. We're just not going to have that. But what we do need to be sure is that is there buy-in on the part of the Commission? This is a multiyear effort.

MEMBER WALLIS: Well, I'm not --

MR. THADANI: Here are the issues that we need to go forward with. We need to have some confidence.

MEMBER WALLIS: Let me be a member of the public here. I mean just because the Commission is going to make some decisions doesn't mean that they're right decisions. You've got to provide enough information to make darn sure that they make the right decisions. That's what I'm confused about.

MR. THADANI: That's fair. And I would like to think that we have already got some information that obviously would be supplemented by what we learn over the next several months. But we're not going to go to Commission with no information. We're going to lay out what we know and what needs to be developed further, and that's part of the idea behind the research plan.

MR. KRESS: You're not going to them and asking for resolution of these issues at this time, are you?

MR. ELTAWILA: We need --

MR. KRESS: You're just going to say, "Are these the right questions?"

MR. ELTAWILA: Right. Are these the areas -- if the Commission says upfront that, "We just don't want you to pursue high-level safety principles approach," we'd like to know that.

CHAIRMAN APOSTOLAKIS: One of the things that I would appreciate if I were in their shoes is what lessons did we learn from the current regulatory system? Some of them are obvious, of course, but, for example, yesterday we had a marathon Subcommittee meeting of ten hours on CRDM cracking and Davis-Besse and so on. Let's say we license a reactor to 2030. Would there be a subcommittee in 2050 for ten hours looking at something unexpected and trying to fix it?

MEMBER WALLIS: Yes.

CHAIRMAN APOSTOLAKIS: There would be?

MEMBER WALLIS: Yes.

MEMBER WALLIS: Why? Why are you so confident that there will be?

MEMBER POWERS: Because no one has ever gone broke underestimating human capabilities.

CHAIRMAN APOSTOLAKIS: Well, but --

MEMBER POWERS: George, the world is far more complicated than the rationalists think it is.

CHAIRMAN APOSTOLAKIS: This was a major thing with that Voltaire stock, you know.

(Laughter.)

Well, but if that's the case, then the policy decisions that we're making now somehow we'll accommodate for that, which brings us back to the structure as defense in-depth. But how far can you push that? See, that's the real issue.

MR. SALSBERG: Well, I think there's another thing, though. I mean how far do you want to accommodate that in the design, and how far do you accommodate that in a kind of performance regulation?

CHAIRMAN APOSTOLAKIS: And I fully agree with that, but I tell you, before Three Mile Island I was a major player in the PRA we were doing for the industry. If you dared say that the operators would do something wrong, you were out of the project, because the industry did not believe that the operators could make a mistake, period.

MR. SALSBERG: Your PRA is never going to postulate every error that --

CHAIRMAN APOSTOLAKIS: Nobody paid attention to the PRAs. As Rasmussen said, it was a status symbol. Everybody wanted to have the blue reactor safety study but nobody read it except him and Levin.

MEMBER POWERS: George, to think that --

CHAIRMAN APOSTOLAKIS: Well, you're not giving me a warm feeling here that we're going to have these Subcommittee meetings --

MEMBER WALLIS: You can't have a warm feeling, George, it's just the way it is.

MEMBER POWERS: And what you would hope for are one or two of them and not a marathon of marathons.

CHAIRMAN APOSTOLAKIS: Well, I didn't get the answer I wanted, but --

MR. SALSBERG: Let me just ask sort of a practical question, as a pragmatic sort of guy.

CHAIRMAN APOSTOLAKIS: Are you saying that the questions so far have not been?

MR. SALSBERG: If I go with -- everything I hear is PRA and uncertainties. Now, you know, we talk about public acceptance. If I have to come in and defend a PRA down to whatever level I want to get down to, in a public litigation sort of situation, it seems to me that's an endless discussion. One of the things I like about a design basis is there's a very concrete acceptance kind of criteria with limits, and I just have a very difficult time in the sort of judicial approach in the litigation nature of Americans --

CHAIRMAN APOSTOLAKIS: But nobody's proposing that, Bill.

MR. SALSBERG: Well, I hear some things that sound a lot like that.

CHAIRMAN APOSTOLAKIS: No, no. It will be deterministic requirements based on probablistic arguments.

MR. KRESS: And even selection of design basis accident.

CHAIRMAN APOSTOLAKIS: Yes. But you will never go and argue probablistic, because you'll never finish.

MR. THADANI: In the end, that's what we

meant here. Once you go -- if you go with frequency consequence approach, you still -- you can do that in the abstract even --

CHAIRMAN APOSTOLAKIS: Yes.

MR. THADANI: -- without knowing what number sequence. You can do these things. But you still, and Graham's point is valid, that you need design information, you need to -- if you're going to rely on PRA, you need to have some level of confidence in that. And what we're suggesting is once you lay out this plan and once you have confidence in the analysis, you can define certain events that sort of become part of the design base and that you make hopefully more rational decisions regarding the requirements for structure systems and components. That's the thinking. But it's got to go through a process, and I mean we're just sharing with you our early thoughts.

CHAIRMAN APOSTOLAKIS: Yes. Acceptance criteria will have to be deterministic. Otherwise there's no end to this.

MEMBER POWERS: Right. I'll just kick in, Farouk, I think you guys have really come up with a really nice set of questions.

MR. KRESS: Yes. That was my --

MR. ELTAWILA: Well, I really -- I don't want to leave you with that we only have questions and we don't -- I think we have the technical basis and the technical basis is going to be sharpened between now and October.

CHAIRMAN APOSTOLAKIS: We understand that.

MR. ELTAWILA: Okay. Thanks.

MR. KRESS: I think that's --

CHAIRMAN APOSTOLAKIS: Are there any other comments from members of the public or the staff? Thank you very much. Gentlemen, this was very, very informative. It was a little low-key, I would say, but thank you.

MR. THADANI: Farouk took too long. That's the only problem.

(Laughter.)

MEMBER POWERS: As usual.

CHAIRMAN APOSTOLAKIS: We'll recess for eight minutes and come back and give advice to our colleagues on the letters.

(Whereupon, the foregoing matter went off the record at 5:40 p.m.)