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UNITED STATES NUCLEAR REGULATORY COMMISSION'S

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

NOVEMBER 9, 2001

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

487TH MEETING

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FRIDAY,

NOVEMBER 9, 2001

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ROCKVILLE, MARYLAND

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

COMMITTEE MEMBERS:

GEORGE E. APOSTOLAKIS, Chairman

MARIO V. BONACA, Vice Chairman

NOEL F. DUDLEY, Member

F. PETER FORD, Member

THOMAS S. KRESS, Member

GRAHAM M. LEITCH, Member

DANA A. POWERS, Member

STEPHEN L. ROSEN, Member

COMMITTEE MEMBERS: (CONT.)

WILLIAM J. SHACK, Member

JOHN D. SIEBER, Member

GRAHAM B. WALLIS, Member

ACRS STAFF PRESENT:

JOHN D. SIEBER, ACRS

SAM DURAISWAMY, ACRS/ACNW

HOWARD J. LARSON, ACRS/ACNW

SHER BAHADUR, ACRS/ACNW

CAROL A. HARRIS, ACRS/ACNW

JOHN T. LARKINS, ACRS/ACNW

MAGGALEAN W. WESTON

MEDHAT M. EL ZEFTAWY

MICHAEL T. MARKLEY

ALSO PRESENT:

LARRY MATHEWS

STEVEN MOFFAT

WARREN BANFORD

ALLEN HISER

ED HACKETT

KEN BYRD

ALEX MERRION

JACK STROSNIDER

RAJ PATHANIA

DAVE GEISEN

ALSO PRESENT: (CONT.)

MARK REINHART

TOM KING

N. PRASAD KADAMBI

ERIC J. BENNER

JIM LYONS

EDWARD McGAFFIGAN (Commissioner)

TONY ULSES

STEWART BAILEY

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 second day of the 487th meeting of the Advisory Committee on Reactor Safeguards. During today's meeting, the committee will consider the following: circumferential cracking of PWR vessel head penetrations; licensing approach for the pebble bed modular reactor design; future ACRW activities/report of the Planning and Procedures Subcommittee; reconciliation of ACRS comments and recommendations; preparation for the meeting with the NRC Commissioners; proposed ACRS reports.

In addition, the committee will meet with Commissioner McGaffigan to discuss matters of mutual interest.

This meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act. Mr. Sam Duraiswamy is the designated federal official for the initial portion of this meeting.

We have received a request from the Nuclear Energy Institute for time to make oral statements regarding circumferential cracking of PWR

vessel head penetrations.

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

I would also like to remind Members that during lunch time we are scheduled to interview three candidates for potential membership on the ACRS.

The first item on our agenda is circumferential cracking of PWR vessel head penetrations. Dr. Ford is the cognizant member and he will lead us through the discussion.

MEMBER FORD: Thanks, George. In July, we heard a presentation on the proposed bulletin relating to the vessel head penetration cracking. At that time, we wrote a letter to Chairman Meserve indicating that the bulletin was both appropriate and timely. Bulletin 2001-01 was issued on August 3, 2001.

In the response back to us from the staff, it was indicated that the update on the staff assessment will be given early next year. That's 2002. Because of the urgency and importance of this issue, the committee decided to request an interim presentation on the status of various issues that came

up in the July meetings. These issues included risk assessment, prioritization algorithms, evaluation of inspection methods, responses to the bulletin and question of cracking initiation and kinetics, both for the axial and circumferential cracks.

Therefore, the purpose today is to hear generic discussion of these issues. There's no plan at this stage to issue a letter.

As you heard from the Chairman, NEI has requested -- I'm just looking for the Member from NEI -- has requested to make a statement. We'll hear that statement at the end of the industry presentation.

We'll begin with Larry Mathews from MRP.

MR. MATHEWS: My name is Larry Mathews. I'm with Southern Nuclear Operating Company. I'm the Chairman of the Alloy 600 Issues Task Group of the Materials Reliability Program.

I'm just going to provide an update on a few issues of where the industry is on some of these issues with respect to the head penetration cracking.

Some of the topics I'm going to address quite briefly is the crack growth rate in the annulus environment, not the details of what we're doing in that regard; the risk assessment, where we stand on that; inspection impacts on susceptibility. We've had

several plants inspected this fall. Does that have any impact on our rankings? Recommendations that we may be making for the spring outages and the ASME code activity that's going on.

In the area of crack growth rate, I'm not sure if I told you this last time, but I think, I believe I did. We were convening an expert panel to try and assess what's the appropriate crack growth rate to use when evaluating this phenomena. That panel, which consists of members from all over the world, convened for the first time in August, kind of an introductory, get to know what they're going to do meeting. Then they had a second multi-day meeting in Airlie in October, the first part of October. Numerous phone calls and discussions have taken place amongst those Members since then and they produced the first draft of a report on Alloy 600 on October 22nd.

As the industry reviewed that, we had many, many comments on the structure and the content of the report. Those are being incorporated and not just us. Dr. Shack had comments on the thing too, so those are being addressed. The second draft is expected out next week and we're scheduling the report on crack growth rate from the expert panel for publication at the end of this month.

MEMBER FORD: In terms of communication, ease of communication, has any of this information from this expert panel been transferred to the NRC staff?

MR. MATHEWS: I don't believe we've sent the draft to them yet. Dr. Shack was on the committee and I believe he's seen the draft of the report, first draft of the report and so that's as far as it goes. We haven't sent anything else yet, but we've gone back and tried to incorporate and I'll get into some of what we've tried to do.

MEMBER FORD: The reason for my question is because of the urgency, I just want to make sure there's plenty of backwards and forwards.

MR. MATHEWS: Yes. I guess the extent of that is Dr. Shack has been given the draft and commented on it.

MEMBER FORD: Sure.

MR. MATHEWS: The process they went through was they established some data screening criteria. There's lot of data out there on Alloy 600. Not all of it is of the same quality so the expert panel established some criteria for selecting the data sets and then the data sets that were to be used were selected and initially a best fit curve was put in the

report and that was it. Some of the comments from the industry were we need to put in the kinds of curves we need to address, what the data is going to be used for. So some of the curves that are being investigated at the moment are heat to heat variability, is there some effect there that needs to be accounted for; the widespread in the data, there is a very wide spread in the data; what amount of conservatism needs to be put into the curve if you're using it for deterministic evaluations; is that the right same curve or should you use a different curve if you're doing probabilistic evaluations? And also, the annulus environment.

One of the things -- the things the expert panel has determined is that the environment that is possible in the annulus after a leak established is about the same as a primary water as far as the impact on crack growth rate. And it doesn't matter that much where the boiling transition takes place inside the crack, at the exit. The only times there's potential any impact, as I understand it, is when the boiling transition is right at the crack.

MEMBER FORD: I recognize you don't have very much time today and obviously we'll be having another meeting with the Materials Subcommittee. We

have a whole day to go through all the ins and outs of this.

Can you give us some feeling about where you stand right now in terms of the choice of a disposition curve for both axial and circumferential cracks? Is it going to be a mean? Is that the way you're moving?

MR. MATHEWS: I doubt that it will be a mean for a disposition curve or for probabilistic, we're still trying to decide. It may be a mean for a probabilistic evaluation, but even there you have to -- we have to look at what's the effect of heat to heat, how do we really handle those kinds of variations and I don't think it will be a mean curve for disposition. There will be some conservatism in a disposition curve, but then again we're not really talking about dispositioning a circ flaw above the weld. Those will typically be repaired and so we're not going to find one and try and figure out how long we can run with it. We can't run with it. So what we do there will be different than if it's a short axial flaw and we're trying to disposition that then there's also the dispositioning of the hypothetical flaw and we've got to figure out how to handle all of that.

MEMBER FORD: I was just looking through

your presentation here. This is the only slide there is because there's no data and there's a lot of technical discussion necessary.

When do you think you'll be ready to discuss this?

MR. MATHEWS: We're intending to try to publish this by the end of the month and we will have discussions in our meeting that's scheduled with the NRC at the end of the month on the 27th.

MEMBER FORD: Thank you.

MR. MATHEWS: The second draft is due out next week. Hopefully, we will -- that will be the final one or shortly thereafter we'll be able to publish it.

One of the things we found out yesterday or it appears that there may be some differences in the data sets that have been used by the staff and the ones that the expert panel used, so those things have to be addressed very quickly I think.

MEMBER FORD: Okay.

MR. MATHEWS: Anything else?

MEMBER FORD: Well, there's lots and lots of questions.

MR. MATHEWS: That is the only slides I have on the crack growth rate and that's a very

important topic because it drives a lot of stuff and we need to reach resolution on that area and we recognize that and we're moving toward that as fast as we can.

In the area of risk assessment --

MEMBER POWERS: Maybe I don't understand quite. What is it that's so crucially dependent on knowing the crack growth rate?

MR. MATHEWS: How long you have -- well, the crack growth rate can have impacts on reinspection intervals. It can have impacts on how long you can run, once you find an acceptable flaw, how long does it remain acceptable and those kinds of things. And it also has an impact on the probabilistic fracture mechanics that you fold into your industry risk assessment. It drives and feeds into a whole bunch of aspects of this issue.

MEMBER POWERS: Yes, as long as one is willing to operate the flaws, I see that.

MR. MATHEWS: Yes. Well, even if you're trying to assess the probability of core damage or the frequency of core damage on the mere presumption that there may be a flaw.

MEMBER POWERS: It will usually come out three times the life of the universe or something like

that.

MR. MATHEWS: We hope so.

(Laughter.)

MEMBER POWERS: Doesn't mean I believe them, but that's the way they always come out, so it doesn't matter what number you put in.

MR. MATHEWS: Well, in the area of risk assessment, the preliminary work was performed for the various plant types, some preliminary work. We had a meeting this week to finalize our approach for the industry and how to bring these various approaches that were put together.

What we're looking at is using industry statistics for probability of a thru-wall flaw versus time to get -- that gives you then the probability of initiating a thru-wall flaw. Then we're using probabilistic fracture mechanics to determine the probability of crack propagation versus time from the time of the leak to the thru-wall or the rupture.

The conditional core damage probabilities for results of LOCA and rod ejection will be assessed from either generic industry numbers or plant specific numbers and those should include any effects of collateral damage that may happen. And then finally, the core damage frequency --

MEMBER POWERS: I don't understand your language here. You have probability fracture mechanics for probability crack propagation versus time from leak to thru-wall or rupture.

I mean if it's leaking isn't it through the wall?

MR. MATHEWS: There's a couple of ways to get a leak and if you had a leak through the weld, the thru-wall we're talking about here is thru-wall in the direction that could lead ultimately, if it grew far enough to an ejection.

You can get water on the outside in the annulus region by a leak through the weld that's an axial leak that does not threaten the ejection of the rod. Then what we're talking about is using from the time you've got that leak to the time that the crack could turn circumferential and grow through the wall and/or grow all the way around until it ejects.

MEMBER POWERS: It's really not thru-wall so much as being circumferential.

MR. MATHEWS: Yes, thru-wall in the plane, that is a circumferential flaw. You can get a leak from an axial flaw which has no -- does not threaten a LOCA or an ejection. Once you get that, how does it grow back toward the potentially dangerous flaw of the

circumferential flaw all the way around. And the thru-wall component, they're talking about there, how does that crack propagate until it's a thru-wall position. Well, it just goes -- we propagate it probabilistically all the way until it gets to the limit.

MEMBER POWERS: I'm trying desperately to remember language of general design criteria, but it seems to me once we have a leak, we are in violation of having a leak type primary piping system.

MR. MATHEWS: Yes. We're not arguing that.

MEMBER FORD: Larry, at the meeting we had both to the Materials Subcommittee and then to the Full Committee earlier this year on this particular topic, you came under a fair amount of fire, I seem to remember, for the assumption that you made on initiating event frequency. Since that time I know Oconee has given a public meeting here to the staff on that issue.

Could you, for the members, give a kind of bottom line conclusion from that meeting?

MR. MATHEWS: I'm not sure -- I wasn't there, and I'm not sure I know the specifics of what they presented at that meeting.

MEMBER FORD: Okay.

MR. MATHEWS: They were -- I have seen numbers of -- in one of the approaches, one and a half flaws for an assumption, but that's for a given set of plants at a given point in time. Most of the other plants were much, much lower on the susceptibility curve and therefore the probability of having a leak at this point in time.

And what we're trying to assess is that probability starting now and into the future for each and every unit and you can use the data that has been gathered on the plants that do have leaks and the plants that don't have leaks at this point in time to come up with some distribution and I believe there's a wide distribution that they're trying to use to come up with a --

MEMBER FORD: But there will be a uniform industry argument on this particular risk assessment issue for discussion with the NRC staff?

MR. MATHEWS: Yes, there will. That's our intent.

MEMBER FORD: And that will be presumably by the end of this month, November?

MR. MATHEWS: No, no. That was the crack growth rate. It's going to take a little bit longer

to get all of this pulled together. It's probably going to be in the January time frame.

MEMBER FORD: Okay.

MR. MATHEWS: Before spring outages for the most part, we should have some results.

MEMBER FORD: Okay.

MR. MATHEWS: We've seen this curve before, except that I've changed it a little bit and I put up there who has which units have leaks, which units have had cracks, but have not discovered leaks on their head, which units have done visual examinations with no leaks and then the ones that are later. It's hard to see up close, so I got it blown up for the first 30 years. This was our ranking of the units and when we put it together it was a quite simple ranking. We all know time and temperature of the head and if you look at the plants that have had leaks to date --

CHAIRMAN APOSTOLAKIS: Could you explain a little bit. Don't assume we know.

MR. MATHEWS: Okay, I'm sorry. This bottom axis is the effective full power years that it would take a unit normalize to 600 degrees Fahrenheit head temperature to reach the same effective full power years calculated for Oconee 3 at the time they

shut down and discovered their numerous flaws at Oconee 3. So we use Oconee 3 as the base point and then we normalized all the plants to that same, to an effective full power year number that would be equivalent to an equivalent head temperature of 600 degrees.

Using that then, we just ranked the plants as far as how far away they were in time until they would reach that same equivalent time at temperature.

CHAIRMAN APOSTOLAKIS: So if I go to EFPY 10 and I go up and I find 20 on the left --

MR. MATHEWS: Okay that means --

CHAIRMAN APOSTOLAKIS: What does that mean?

MR. MATHEWS: What that means is that the highest ranked 20 units in the country are less than 10 years from being equivalent to Oconee 3.

CHAIRMAN APOSTOLAKIS: The highest ranked?

MR. MATHEWS: Right, or if you go up the left column, 20, the 20th ranked plant, if you rank them sequentially, the 20th ranked plant would be 10 years away from Oconee 3.

CHAIRMAN APOSTOLAKIS: They would be weighed in what sense?

MR. MATHEWS: It would take 10 more years

of operation, effective full power years of operation at their head temperature to reach the same time at temperature equivalent as Oconee 3 normalized to the 600 degrees.

CHAIRMAN APOSTOLAKIS: I see.

MR. MATHEWS: So it's just a way that we could rank plants based on time and temperature, how far away are they from being equivalent to Oconee 3 and the number up the side is just the rank order of the units.

CHAIRMAN APOSTOLAKIS: Now what I see there at that point is a circle, a green circle and up there it says later.

MR. MATHEWS: And that means that that unit has not had an outage done and inspection of their vessel head to date since Oconee 3 and since we put this February 2001 was our normalization point.

VICE CHAIRMAN BONACA: Now I see a 6, I see one unit with a triangle there, a red triangle?

MR. MATHEWS: Right, and that unit has done an inspection of their head. I believe it was this fall and discovered a leak on their head, at least one.

VICE CHAIRMAN BONACA: So although it would take 6 years for it to get to the same

temperature --

MR. MATHEWS: Same time.

VICE CHAIRMAN BONACA: Oconee still has leaks. Why wouldn't that plant -- I'm trying to understand that the reference is to Oconee.

MR. MATHEWS: Well, we can change the reference. If we change the reference all that does is move Oconee to a negative number.

VICE CHAIRMAN BONACA: Okay, I see. All right.

MR. MATHEWS: We just selected Oconee 3 at that point in time because it was the worse cracking that we had observed to date at the time we put the initial --

VICE CHAIRMAN BONACA: It's logical, all right.

MEMBER FORD: At the time this was thought about, the temperature time algorithm was a reasonable start.

MR. MATHEWS: Yes.

MEMBER FORD: As you stand right now, are there any surprises from the algorithm telling you that there's something physically wrong with it? In other words, just glancing at it, it seems that you don't have any red triangles all the way to the right.

Thank goodness.

MR. MATHEWS: That's true. There are no red triangles to the right. We do have some blue diamonds to the left, at least one or two and have done visual exams of their head and not discovered leaks.

MEMBER FORD: Right.

MR. MATHEWS: We have some other green circles over there that haven't looked yet. We have plenty of "haven't looked yets" right in here. So -- and on out. So we don't see anything, I don't see anything here that really surprises me and says the model that we're using is just a totally ineffective way to address the issue. The plants that have discovered leaks are the plants that are high in the susceptibility ranking here at time and temperature.

There are plants, we're starting to get into plants that don't have leaks or don't have observed leaks that are intermingled here. It's not a perfect model by any stretch of the imagination, but we are starting to get to the point where we're seeing some that don't have leaks.

MEMBER FORD: Is there anything in these observations that intimate that, for instance, different -- they're all hot head plants, but is there

anything that would intimate that plants of a certain design would be more likely to crack than not at a given EFPY?

MR. MATHEWS: Well, there are many leaking plants here. Seven plants, I believe, here that have red triangles.

MEMBER FORD: Right.

MR. MATHEWS: Six of those plants are BNW design plants.

MEMBER FORD: Yes.

MR. MATHEWS: One of those plants is a Westinghouse-designed plant. There's a wide variety of materials that were used to make the head penetrations throughout the industry, especially on the Westinghouse units. So that's one of the things we're starting to look at, is there some segregation of the population that we could do. One of the plants that did have a leak, their cracks were entirely contained in the weld metal and so we have to say well, do we know enough to talk about the specifics of the weld metal for all the rest of these plants or is time and temperature going to ultimately be the thing we use all along. And we're not sure yet. We're assessing the data continuously as it comes in.

VICE CHAIRMAN BONACA: Given that you have

this dependency evidently. I mean most of the red are for one type of plant. Is it reasonable still to put all these kind of different designs, etcetera on the same plot?

MEMBER FORD: That's the reason for my question is can you read out from that that there is a --I don't know, a heat to heat or a fabrication style?

MR. MATHEWS: Certainly, we hope to ultimately to be able to figure out what those parameters are and characterize them and start to sort this data into bins. And we've already sorted -- not this data, but we're starting to look at well, who has what type of material, what type of tubes and as we get more inspection data, a lot of the types we don't have much inspection data on yet, but as we get more inspection data, we'll be able to say well, this doesn't look quite as susceptible as it should be, you know. We should be seeing some indications here and we don't. So we can maybe sort that out. But at this point in time we don't think we have enough information to start to do those discriminations.

MEMBER FORD: But based on the data you have so far, the historical data you have so far, it is real to suppose those three open circles run about

3 EFPY if they were inspected, you would expect to see cracks, based on that data?

MR. MATHEWS: I would say it wouldn't surprise me to see cracks there.

MEMBER FORD: Okay.

MR. MATHEWS: Because they're not -- there's material variabilities, etcetera there.

MEMBER FORD: Sure.

MR. MATHEWS: And it wouldn't surprise me to see some cracks, but it's not going to surprise me to not see some either.

MEMBER FORD: Thank you.

MR. MATHEWS: When we look around the industry we already have several plants that have decided that it's the right thing for them to do, based on their ranking and their decision making process, etcetera, that they should be doing some under the head NDE inspections and part of that could be tied to the difficulty that they would have doing a visual inspection because of their particular insulation package, but we have several of these plants that have already told us that they probably will be doing inspections this next spring and next fall and we have a draft industry inspection program under review where we're trying to say is this enough,

we're looking at the ones that are volunteering and saying is this enough? If not, what do we need to do as an industry and we're working on that right now and that program is under review and when we get through, if it's a published recommendation we'll be sharing that.

MEMBER FORD: On that basis and I'm referring back to the previous one, do you remember we asked whether it was possible to improve this prediction algorithm.

MR. MATHEWS: Yes.

MEMBER FORD: Are there -- where do you stand on that right now or do you not see any reason to improve it at this time?

MR. MATHEWS: We'd love to be able to separate the whole rest of the fleet from the ones with the red triangles, but do we have the data now to do that? We don't. We need some more data to be able to sort out and figure out which plants might be able to be separated and which ones belong in the same population.

MEMBER FORD: I recognize it's a complex problem, but from a cost-effectiveness point of view, is there any point in continuing with that effort to try and improve on the --

MR. MATHEWS: Improve on the modeling?

MEMBER FORD: Yes.

MR. MATHEWS: Well, it's pretty simple to do this model.

MEMBER FORD: I'm sure.

MR. MATHEWS: And as we get into it, you have to look at the parameters you're looking at. If you've got great lab data on a parameter, but you don't know what it is in the field, there's no point in chasing it and so we're -- that's like the welds. If we knew exactly what properties caused the weld to crack, that may or may not be of any benefit if you don't know what the properties are for all the plants.

MEMBER FORD: Sure.

MR. MATHEWS: So that's the kinds of things we're having to weigh, but right now we're still going with the time and temperature and trying to gather data. We know what the subsets are as far as materials, etcetera, but right now we're still having them write this way.

MEMBER FORD: Okay.

MR. MATHEWS: As far as the long range, NRC has indicated that the inspection criteria for head penetration area in the ASME section 11 code is potentially inadequate or has been over the years,

although we haven't really had an action because of that, but they feel that it needs to be modified. So Section 11 has established a working group to look at the Alloy 600 inspection requirements that are in the Section 11 code right now. They met at the last Section 11 meeting and they'll be meeting again at the December meeting and I believe there's at least one draft of something that they'll be discussing at the December meeting.

I'm not sure how quickly the code moves, but ultimately, long range down the road, I believe Section 11 will have some requirements that they will put into place that will be a long range inspection program.

We need to work with them because some plants are replacing heads and they're using much more resistant material, so we need to figure is that the right -- make sure that whatever gets into the code for inspection doesn't overpenalize people who go into proactive or necessary head replacements.

That's all I have. I have used my half hour almost exactly.

MEMBER LEITCH: Just one quick question. The visual with no leaks, the blue dots on your histogram?

MR. MATHEWS: Yes.

MEMBER LEITCH: Refresh my memory, what does that mean? You looked for boron and found none? That was the extent of the examination?

MR. MATHEWS: Yes, that's what it means but it was at least an effective visual which means that you got a good hard look at metal to metal interface where the penetration goes inside the interference gap on the head. And saw no evidence of leakage on all of those plants.

Now NRC's requirement was that we absolutely demonstrate for plants less than 5 years if you were doing a visual that it be a qualified visual which means you demonstrate it would leak and for the others out to 30 years they didn't require that demonstration at this point.

Some of these plants have done some work to demonstrate that they believe most, if not every single one of their penetrations would leak if they had a crack. Others have not done that to date.

MEMBER LEITCH: Okay, thank you.

VICE CHAIRMAN BONACA: Just before you take it down, of these plants, how many of them have exhibited this circumferential cracks?

MR. MATHEWS: I believe three plants had

circ flaws: Oconee 3, Oconee 2 and Crystal River.

VICE CHAIRMAN BONACA: So they are spread.

MR. MATHEWS: Two of them are real close and then the other one is out.

MEMBER FORD: The uppermost triangle is Crystal River, uppermost red triangle?

MR. MATHEWS: I believe.

MEMBER ROSEN: You said that the small cluster is down between 0 and 5?

MR. MATHEWS: These three.

MEMBER ROSEN: If you found the plant in that group that had a leak, that it wouldn't surprise you, am I right?

MR. MATHEWS: Right. It would be consistent with the data from the other plants.

MEMBER ROSEN: Now what about the next open circle that you see up around 6 or the next one after that, 7th. If they had a leak, would that surprise you?

MR. MATHEWS: It becomes more and more of a surprise the further to the right you go.

MEMBER ROSEN: That's what I'm trying to figure out. What is your crack definition?

MR. MATHEWS: I don't have one. I don't know. The data is out there. We're trying to gather

the data to figure out where it is.

We didn't try to use this as a predictive model to say this plant will leak in X number of years. What we were trying to do is say these are the plants that -- on a time and temperature basis any way, the highest in rank and they're the ones we really need to be concerned.

MEMBER ROSEN: I know from listening to you that the ones below 5 would surprise you and I think if you saw a crack between 25 and 30 that would surprise you. The ones between 25 and 30 would surprise you. The ones between 0 and 5 would not. So I have two points on the curve.

(Laughter.)

CHAIRMAN APOSTOLAKIS: Are you plotting being surprised?

MEMBER ROSEN: I'm trying to figure out when we should say oops, this isn't working.

MR. MATHEWS: I think a leak in the 30-year time frame certainly would warrant, whoa, what's going on, a whole bunch more, no leaks down in the 5 to 10 year range doesn't.

MEMBER ROSEN: Yeah.

MEMBER FORD: You are looking at how a scatter band of depths is impacting over time and so

you expect if all the plants were exactly the same design, manufacture, there should be a clear cut, but they're not. Is there any reason -- the reason I'm asking the question, between cracking and no cracking on that curve. That's why I asked the question can you put a normal cut between, for instance, Westinghouse and Babcock on that?

MR. MATHEWS: Part of the unfortunate thing about trying to do something like that is all of the BNW units happen to be very high in the ranking on time and temperature.

MEMBER FORD: Because of time primarily. These are 600.

MR. MATHEWS: Just from a time and temperature basis, they're very high in the ranking.

MEMBER FORD: Right.

MR. MATHEWS: They were all built fairly close together in time. They all run with fairly high head temperatures relative to the rest of the industry and so when you couple those, it pushes most of the BNW units --

MEMBER FORD: It is primarily time, isn't it, Larry, because most of these are 600 plus or minus 2 head temperatures. Is that correct?

MR. MATHEWS: Well, some of these units

are probably even on down into the 590, 580 range.

MEMBER FORD: Okay.

MR. MATHEWS: Well, maybe not these. These may not be down in the 580, but some of the plants on the higher end up here are in the final --

MEMBER ROSEN: Some are even lower than that.

MR. MATHEWS: Yes. If you look at the curve for the entire fleet it goes all the way out. Most of these plants are designed such that their head temperatures are calculated to be very near the cold lake temperature.

MEMBER ROSEN: Right.

MR. MATHEWS: And these are either hot head or warm head plants.

MEMBER ROSEN: Right.

MR. MATHEWS: The Westinghouse design diverts a little of the cold lake flow up there and it varies from design to design. But most of these plants out in here have what we call cold heads. Their heads have enough cold lake flow diverted to the head and they're operating at significant lower head temperatures than most of the other fleet.

MEMBER ROSEN: Okay.

MR. MATHEWS: Now the BNW designs tend to

be even on the high end of the head temperatures, over 600 and most of the Westinghouse plants are a few degrees under 600, NCE plants.

MEMBER ROSEN: Okay. Have you got all the inspection results in for the fall outages that's shown on this curve?

MR. MATHEWS: I believe North Anna 2. Well, we've got all of them that are complete. And we've got all of them that are -- I believe all of them that have discovered any leaks, even if they're not completely through with their exam is on there. There's a few units that are down now that have not finished their exam and I don't know if they've found anything or not. So --

MEMBER ROSEN: I'm going to take your answer to mean there may be some new data yet from this set of fall outages.

MR. MATHEWS: Absolutely.

MR. BANFORD: There's one more green diamond in the less than 5 year.

MR. MATHEWS: Green circle.

MR. BANFORD: That we just became aware of about two days ago. Warren Banford from Westinghouse. So one of the three open circles in the 0 to 5 is now a green circle.

MR. MATHEWS: A blue diamond.

MR. BANFORD: Or a blue diamond.

MR. MATHEWS: Visual with no leaks. I guess that that's within the last two or three days that that came out.

Well, it won't change the color. Oconee is down and I don't know how I'm going to plot this when -- if they come down and don't find anything this time, how do I plot that. Successful repair.

MEMBER FORD: I'd like to bring this one to a close unless there's any urgent questions. But is it my understanding, Larry, that by December if we had a Materials Subcommittee meeting in December, you would have a full technical data presentation on the -- at least on the cracked assessment?

MR. MATHEWS: Crack growth rate?

MEMBER FORD: Yes.

MR. MATHEWS: I think we can --

MEMBER FORD: And the annulus would not be a waste of time, I believe to have a meeting at that time if that's what we decide.

Larry, thank you very much. I'd like to call upon now Steven Moffat of Davis-Besse. I think it's 10 minutes.

MR. MOFFAT: Thank you. I have a power

point type presentation that starts with Davis-Besse. Again, I'm Steve Moffat from Davis-Besse. I'm the Director of Technical Services.

With me is David Geisen and Ken Byrd who are on our staff. We also have several of our subject matter experts who contributed from an industry perspective to our discussion this morning with us in the audience. First off, I'd like to sincerely thank the ACRS for allowing us this opportunity to give what could be characterized as a case study of some of these diamonds we just saw as relates to Davis-Besse.

Our objective today is to have ACRS consider additional industry information as it deliberates on the Control Rod Drive Nozzle cracking issue. Obviously, this is an evolving issue. There's information we recently got from the staff on positions relative to this issue and we'd like to include the additional information today in formal correspondence to the NRC that may be related to regulatory action.

As we heard Larry talk about consensus documentation at this point in time, what we have done is used the best industry data we could in order to determine what would be appropriate action for us based on the safe operation of our power plant. Our

reason for request is that Davis-Besse is considered a high susceptibility plant as discussed in Bulletin 2001-01, specifically the time and temperature model puts us within three years of -- actually, slightly over 3 years of the adjusted Oconee 3 data that we saw a minute ago.

MEMBER FORD: So you're one of those open circles?

MR. MOFFAT: We are one of the "to be inspected" --

MEMBER FORD: To be inspected open circles.

MR. MOFFAT: Yes sir, that's right. And as indicated here, we are the only high susceptibility plant that's ranked by the Bulletin that will not perform a visual inspection by December 31 of 2001 and we've used these subject matter experts, as I referred, to assess the impact of the continued safe operation of our plant until our next scheduled refueling outage which is currently scheduled for the end of March of 2002.

As far as Dave is essentially a deterministic engineer and Ken is a probabilistic, some of the discussions will go in that area in my brief presentation. As far as the deterministic, we

believe we have what could be characterized as qualified visual inspection that was performed in 1996 and additional inspections in 1998 and 2000. My reason for using that terminology is that we had done inspections of the head for other reasons, however, the people that did the inspections are available and we, in fact, videotaped the heads which we have subsequently reviewed in light of the information that evolved as part of Bulletin 2001-01. So this provided us an opportunity to put a new set of eyeballs, if you will, on the historical issue at hand.

What we did with the 1998 and 2000 is essentially utilize that data, albeit limited in our probabilistic assessment of the risk associated with this issue.

As Larry indicated earlier, the majority of our nozzles through out own plant-specific finite element analyses show that they would open which essentially means the visual efficacy of the inspection was adequate.

MEMBER POWERS: I guess, maybe I don't understand that quite. I guess I have a couple of questions about that.

MR. MOFFAT: Certainly.

MEMBER POWERS: If I go in and I look at

these regions and I don't see anything, what is the likelihood that there is, indeed, a crack there I just didn't see it.

MR. MOFFAT: The likelihood due to the fact that we did specific finite element analysis is extremely low because the analysis shows that should there be a crack and pressure --

MEMBER POWERS: It has nothing to do with my vision and your finite element analysis. If I go in and look at your head and I don't see anything, what's the probability that I just missed the crack?

MR. MOFFAT: That human error probability Ken will discuss momentarily, Mr. Powers. We did include that in our probabilistic safety analysis for essentially the ability of a human to detect that. What this is is more of a mechanistic assessment that says should there be a flaw, would we be able to detect that with on head leakage. That's what I'm referring to by the 56 and 69.

MEMBER POWERS: Well, your finite element analysis shows what?

MR. MOFFAT: We looked at the 69 penetrations and of those, 65 of them would open up enough so that we would have a sense as characterized as qualified that we could detect a flaw through

visible leakage boron deposit.

MEMBER POWERS: All right. Thank you.

MR. MOFFAT: Additionally, we perform our own plant specific analysis that essentially would look at the end point as it relates to safety factor of 3 using the code we've discussed previously and have a number that's slightly bigger than the industry data to date as it applies to Davis-Besse. That number is 302 degree flaw as safety factor of 3.

We also believe --

MEMBER FORD: Excuse me, physically, what allows you to make that difference in material properties? I mean what's the --

MR. MOFFAT: I'll let you take that, Dave.

MR. GEISEN: Well, we had the -- the analysis was done by Structural Integrity Associates and when they did their analysis they were looking at the -- using the fracture mechanics with the nozzles and looking at our worse case nozzle in our particular strengths of materials what does that take us out to.

MEMBER FORD: So it's a larger qualifying, larger than you mentioned than who? Industry average?

MR. MOFFAT: Nominally 270 plus or minus several over here. Quite a body of information yesterday, but that's the general characterization

between roughly 260 and 272.

MEMBER FORD: Okay.

MR. MOFFAT: Additionally, in order to look back, as I said previously, with a new set of eyes, assumed an initial flaw size that would have occurred immediately subsequent to our 1996 retrospective, if you will, and believe that we would still have a reasonable assessment that we can proceed until our refueling outage based on that initial flaw size.

And then finally the last deterministic aspect I'd like to go over briefly is just the fact as Larry was showing, we are over the three adjusted effective full power years plus at Oconee Unit 3. Essentially, we're at roughly 6 EFPY as far as the EFPY, but as adjusted for time and temperature, we're a bit over 3.

VICE CHAIRMAN BONACA: A question on the 1998 and 2000 inspections, you said that they were limited.

MR. MOFFAT: Yes sir.

VICE CHAIRMAN BONACA: What was the extent of the inspection?

MR. GEISEN: I'll talk to that. What we did is recognize -- this is Dave Geisen. With regard

to these inspections, recognize that they were not done looking for this particular phenomenon. They were looking for other things. The two inspections done in 1998 and 2000 were really looking for the impact of boric acid leakage from leaky flanges that we had subsequently repaired and what was the impact to that. So the view that we got from those was in many cases some of the drives you couldn't even get a good view of.

There were many cases, the camera angle was looking upwards because it was looking at the structural material of the service structure on top of the head.

When we looked at a 1996 data, you got more of a downward look at these nozzles because we were specifically following around a vacuum and probe that was looking for head wastage as result of the boron being deposited on head. So what really comes down to it, the best video we have on this goes all the way back to 1996.

MR. MOFFAT: So essentially those are some of the characteristics specific to our power plant as plant specific information, as we discussed, given that the body of knowledge related to this issue, what we've done is using Framatone and our own engineering

staff, constructed a probabilistic safety assessment to help us gain an understanding of the significance of the issue as it pertains to our specific plant and for that, I would ask Ken Byrd to present.

MR. BYRD: Davis-Besse has performed a plant specific risk assessment and we base this on the method developed by Framatone, however, we have worked with Framatone to make some improvements and we've also investigated some of the sensitivities to a greater extent with this method.

We acknowledge that there's a number of uncertainties with regard to some of the phenomena we're dealing with and in order to resolve those kind of uncertainties we had to make a number of bounding assumptions. Consequently, the results we see here aren't necessarily consistent with our baseline core damage frequency. These are actually numbers that would have to be looked at as kind of a bounding case for a core damage frequency.

I'll talk a little bit about how we did that. Again, as more information is developed, we can hone this more accurately.

Our results did come out. Our core damage frequency, which again is a conservative number, came out in the category which would be considered small.

Our large early release frequency came out in the category that we considered very small and we did run this through our level 3 PSA and we came out with a negligible public health risk.

I might point out right now because results seem somewhat inconsistent with each other and we have a core damage frequency in one category and a large early release frequency, a public health risk that's much lower. That's consistent with our plant-specific, what we would have expected. We're a large, dry containment. We have a relatively large containment relative to our core power. The consequent that we placed on this was a medium LOCA and we would not expect a medium LOCA to have a significant impact on our containment.

For a large dry containment usually that's containment bypass or interfacing system LOCA or it could be kind of an event which affects a support system such as a loss of cooling or a station blackout and obviously this doesn't deal with any of those kind of circumstances. It is not a significant release issue and certainly not a significant public health issue.

Going on to my second page, what I did here was just listed a number of what I would consider

the most significant bounding or conservative inputs that we use in order to deal with some of the uncertainty that's currently not been resolved yet. Starting out with a nozzle leak frequency, we did base our nozzle leak frequency on information from the other BNW plants, but we applied this very conservatively so that our model estimates that right now we should have nine leaking nozzles and I think that bounds the rest of the BNW fleet. Or actually that was the number that was found at Oconee 3 which is the maximum. Obviously, that would be a lot of nozzles and we wouldn't expect that.

The second thing we did was the probability of the outside dent diameter crack initiation. We assumed that for every axial crack which gives leakage or every leaking CRDM nozzle, we would have an outside diameter crack initiated. Actually, if you look at the data from the BNW plants, we've had 21 leaking nozzles. Five of those have gone to circumferential cracking, so obviously not all of them have initiated circumferential cracking. We're assuming in every case, we will get circumferential cracking.

MEMBER FORD: Can I please interrupt for one second? This hasn't been discussed with the staff

yet, I understand.

MR. BYRD: We've given them our analysis and presented and will discuss this afternoon.

MEMBER FORD: That's just great.

CHAIRMAN APOSTOLAKIS: We have this analysis.

MEMBER FORD: Could I suggest, this is really good input to the overall general thing which we're discussing today. Maybe if you could just move to the bottom line. You've obviously done a lot of work. It's just fantastic. And it's relevant, but it should be discussed with the staff. Could I ask you to move to the end -- to your end conclusion maybe?

MR. BYRD: Certainly.

MEMBER FORD: Based on -- we read these inputs.

MR. MOFFAT: I appreciate that. I'll take it from here. As Ken said, we've submitted this PSA to the staff and we are going to discuss it. It is on the docket. Looking at this as a topic, realizing that we are one of the ones within the three and where we sit from our understanding it becomes an issue essentially is our power plant safe to operate until March, as far as the basis between December 31st and March, as far as our best understanding of this issue

and the expertise that we've brought to bear as a utility and a nuclear steam supply system, Davis-Besse nuclear power station believes that the plant is, in fact, safe to operate until March. We don't believe that the distinctions between December 31st and March are an issue with regard to reasonable basis of safety. So that's our bottom line that you asked me to get to.

MEMBER FORD: I thank you very much indeed, sir, Mr. Moffat.

Are there any overall questions from the Members at this time, bearing in mind that it hasn't been discussed in detail with the staff.

Any questions?

CHAIRMAN APOSTOLAKIS: I wonder what is the actual evidence of the plant regarding this issue? I remember there were circuits there, but have you seen -- maybe I missed it, leaks or --

MR. MOFFAT: What we were able to do, Dr. Apostolakis, by going back through the video tape was to do our best retrospective examination, knowing in light of what is known now of the characteristic which we not only call popcorn due to the nature of this leak. You can tell, based on this body of evidence that we've acquired as an industry what it looks like.

So we essentially went back as best we could at those video tapes from 1996, 1998 and 2000 and that is the evidence that we have for the current condition of our plant. We also use the Peter Scott model to then extrapolate what would bound that should something progress in that interim since we've had those visuals and that's some of the detail that we'll be discussing with the staff when Mr. Byrd has the opportunity today.

MEMBER ROSEN: I'm going back to your second slide, your objectives.

MR. MOFFAT: Yes sir.

MEMBER ROSEN: One was to have us consider the information that you presented here today and I think that clearly is being done.

Your second one was to include, have us include this additional information in formal correspondence to the Commission.

MEMBER FORD: Well, we won't be doing that until the staff has come to us with their --

MEMBER ROSEN: Yes, I don't think we're in a position to do that.

MEMBER FORD: That is correct. Not at this time.

CHAIRMAN APOSTOLAKIS: It can still be an

objective.

(Laughter.)

What we do with it is a --

MEMBER POWERS: As I understand it, they're fighting over four months.

MEMBER FORD: Mr. Moffat, I thank you very much indeed. I appreciate it.

MR. MOFFAT: Thank you.

MEMBER FORD: I'd like at this time to ask the representative from NEI, Alex Merrion to make a statement.

MR. MERRION: I'm Alex Merrion. I'm the Director of Engineering at the Nuclear Energy Institute and I just have a couple brief comments. I want to say something about the susceptibility model and my concern with -- and this is just an observation that people may be reading too much into it. As Larry clearly indicated, it's a simple model primarily focused on two parameters, time and temperature, to try to represent an estimate of who may be susceptible to finding some kind of flaw should they do an inspection.

It's very simple from the standpoint of the kind of degradation mechanism we're talking about which is very complicated. I think as we go through

this, we need to keep that in mind because I find -- I've seen where people in the industry have been looking at that susceptibility model as if it was founded in ground truth and try to make all kinds of conclusions from it. I've also seen people outside the industry reading to much into it, so I felt obligated to make a comment about that.

There was a public meeting held yesterday where the NRC staff provided their preliminary technical assessment on crack growth rate and I have to admit I thought it was an excellent meeting and it's not painful for me to make that admission, but it was very useful and I think beneficial from the standpoint of industry understanding what the staff's current thinking is and I think the NRC benefitted from some of the comments and interactions from that meeting.

And we will be providing comments to the NRC at a public meeting that's been scheduled for the 27th of November on that. We'll probably follow up with some formal communication with the staff and on that meeting on the 27th we'll provide a further update of the industry efforts of the material reliability project and deal with some of these questions that you raised regarding the chemistry and

crack growth rate.

MEMBER FORD: Excellent.

MR. MERRION: And that's all I wanted to say and I thank you for the opportunity.

MEMBER FORD: Any comments? Thank you very much indeed.

MEMBER KRESS: I have a question. You mentioned that the susceptibility model is very simple for a very complex phenomena. Am I to interpret that to mean it could go either way?

MR. MERRION: Yes. Yes, it can and we're in the process of collecting data. That's why Larry was so cautious in making any kind of firm representation of what we know today because it could very well change with the next couple of inspections and it could go either way.

MEMBER FORD: And I think it's also my understanding, however, that this idea of having more than just temperature and time, at temperature, in the algorithm to include weld conditions, heat conditions is very hard to do and many people have tried this over the last 20 years and have failed. And this is the reason behind my question to Mr. Mathews, is it cost effective to try and improve on that? Are you going to materially improve your prediction

capability? That was the reason. You're absolutely correct, it's a question of whether we move forward.

I'd like to move on at this time to cover the NRC staff presentation.

MR. STROSNIDER: I didn't have a lot to say as an introduction and given the time constraints we have, I just suggest that the staff start on the presentation.

I guess I could comment that this is a work in progress. You've heard a little bit already with regard to need for some additional information, but we've been working with the data that are available and trying to pull that into some comprehensive models.

I'm Jack Strosnider from the staff and hopefully you'll get some flavor for that based on this presentation.

MR. HACKETT: Good morning. I'm Ed Hackett from the Office of Research and joining me at the table are Allen Hiser and Mark Reinhart from NRR.

We're going to try, as a team here, to give you a perspective for what the staff has been doing. I guess especially since July as Dr. Ford mentioned. So I was just going to start by summarizing a few items. One was an independent group

of experts, two of whom are here. Your colleague, Dr. Shack, Dr. Gary Wilkauski here who assisted us in performing an independent evaluation of the cracking occurrences, Oconee and ANO. We have also in the Office of Research continued to support NRR specifically in development of the technical assessment that was just mentioned that's in a state of development that's basically deterministic at this time point. What I'm going to focus on briefly in this presentation is aspects of the probabilistic assessment in terms of probabilistic fracture mechanics, but the disciplines that are noted there are the ones that we're providing support on.

If I could just mention briefly that the Office of Research has also provided inspection support to NRR, I believe for two inspections at Three Mile Island and also North Anna. The bottom line of this presentation is that we're working towards and we did discuss this in July. We have made some progress. We're working on developing the elements of a probabilistic fracture mechanics assessment, as is the industry. Structural Integral Associates has had the lead for the industry in that regard as far as I'm aware. We had a conference call with Structural Integrity Associates led by Dr. Pete Riccadella on the

27th of September. I think that was very productive for both us and for the industry in terms of trying to get a baseline as to what's going on. And Alex Merrion mentioned yesterday the public meeting we just completed which was also very beneficial.

Moving on, what we wanted to do is focus on some of the key considerations. I think Larry Mathews and the representatives from Davis-Besse have covered a lot of this information. In our deterministic assessment which the NRR deterministic assessment which was released yesterday, I believe, these are basically sort of the elements that went into what is Section 6 of that report, but obviously key to these types of assessments are the assumptions you're going to making on crack initiation and crack growth rates in specific. In that particular area, Dr. Shack has had the lead for us in the contract work he's done. There's also a lot of variability in the analysis of the stress state for this particular situation and the maintenance of the structural margins. That's an area where Dr. Wilkauski and Dr. Richard Bass from Oak Ridge have helped us out significantly. And then sort of the bottom line of this whole thing, that a number of the speakers have already mentioned is where does this go to in terms of

inspection methods and maybe specifically timing is sort of the crucial element at this point for several plants.

CHAIRMAN APOSTOLAKIS: So what is the ultimate product of this analysis? What is it going to be used for?

MR. HACKETT: The ultimate product, at least in my mind, is a probabilistic assessment that would hopefully be able to give us guidance on exactly this bottom line, inspection methods and timing. The actual, I think the representatives from Davis-Besse were heading there in their presentation and sort of where does this end up in risk space ultimately. I don't think -- we're not ready to discuss that in detail today. I don't think we're there yet and that's what I'm going to come to in the presentation, but I think that's where it's going.

CHAIRMAN APOSTOLAKIS: So if I wanted to keep the probability of risk initiating event or frequency low, then this analysis will tell me how often I will have to inspect?

MR. HACKETT: Yes.

CHAIRMAN APOSTOLAKIS: And what to do?

MR. HACKETT: Exactly.

CHAIRMAN APOSTOLAKIS: And it will include

things about the ability of the inspection method to get an accurate picture --

MR. HACKETT: That would be factored in, would have to be.

MEMBER KRESS: And what would the risk analysis tell you if you calculated just the conditional core damage frequency and the conditional large early release, given that you had the failure of these particular penetrations?

MR. HACKETT: That's a good question and I might turn to my colleague, Mark Reinhart on that one.

MR. REINHART: We've presented that just looking at the IPEs and updates of PSAs to date, the conditional core damage probability for the medium LOCA that we're projecting would result from this type of control drive mechanism ejection is in the 10_{-2}, 10_{-3} range. There's not a lot of debate on that. The issue that Ed's really addressing is the initiating event frequency that we're having the problem with, but if you just assume one on that initiating event frequency, you end up with a CCDP.

CHAIRMAN APOSTOLAKIS: So you will be able to say something about the frequency of a medium LOCA in this mechanism? That's the whole purpose?

MR. REINHART: That's where we're trying to go.

MEMBER KRESS: But from an overall risk perspective, do your conditional probabilities tell you that it's not that big of a deal?

MR. REINHART: I think 10_{-2}, 10_{-3} is -- you can't just say that's not a big deal, if you have the event. I think we're not comfortable just going along allowing this. I think we want to --

CHAIRMAN APOSTOLAKIS: Allowing this for how long?

MR. REINHART: Right.

CHAIRMAN APOSTOLAKIS: I mean allowing forever is --

MR. REINHART: We don't want it to go undetected for --

MEMBER KRESS: I was trying to decide whether there was a real urgency to the inspection and timing.

MEMBER FORD: I was about to address that specific point. This is really a program management chart. And if you look at Larry's temperature time plot, you can see that this is not a one off problem. It's a generic problem and you're going to continue doing it. So what is your timing on this to deliver

this capability, analytical capability to the staff?

MR. HACKETT: That's a good question. I guess that one is mine.

CHAIRMAN APOSTOLAKIS: The only ones you get here --

MR. HACKETT: I'm looking at Gary Wilkauski at this one because we -- the short answer is we haven't exactly worked that out. I think the sort of on-line answer to it would be I think pretty much we were hoping for around the same kind of time frame that Larry indicated, somewhere maybe after the turn of the year, but in all honesty, recognizing the complexity of this problem and we talked about surprises or not being surprised. It wouldn't surprise me if we're still looking at some of this well into 2002, some of the aspects of it. One of the things I'll come to and Dr. Ford as well, I think to really make some progress on this area Jack Strosnider, when we met last time talked about the dangers of the seductiveness of using a PFM analysis in this case and I think they're readily evident here that we're missing a lot of data is the bottom line and being able to generate all that data in the next six months or year, I don't want to be up here telling you we're going to do that.

MEMBER KRESS: That's one reason I asked the question. One way to prioritize would be the conditional probabilities, the ones that have a high condition probability you do first and you sort of bypass all this difficulty.

CHAIRMAN APOSTOLAKIS: Well, there is another issue that, I don't know, maybe it's a non-issue, but it just occurred to me, why should all these decisions be made on the basis of delta CDF and delta LERF?

I mean the reactor oversight process tells me that the staff worries about the frequency of initiating events itself.

MEMBER KRESS: Yes, but only because that's going to affect delta CDF and delta LERF.

CHAIRMAN APOSTOLAKIS: They have declared that they don't want to see higher frequencies independently of what happens.

MEMBER KRESS: That's a defense-in-depth.

CHAIRMAN APOSTOLAKIS: Yes, defense-in-depth. So why don't we apply that here and say okay, the 10_{-2} or 10_{-3} conditional core damage probability is a useful input, but I really don't want the frequency of the medium LOCA to be too large. So on the basis of that, I will also make a decision. Is

that -- are we just using regulatory guide 1174 here or are there more issues?

MR. STROSNIDER: This is Jack Strosnider and I'd like to make two comments with regard to this discussion.

First of all, the question on schedule. And I think with the problem this complex, it's clear that we can continue to do research and collect data and try to refine our analysis for a long time.

The practicality and reality of the situation is that we need to set some priorities and we're going to be looking at that such that we can have some analyses early next year that will help inform what the appropriate inspection intervals and timing is. And I put that in the context of recognizing that the bulletin that's being discussed is just a one time action, right? And the industry and the NRC still have to develop and come to agreement on what the longer term program is for managing this issue. And that has to happen next -- in 2002. All right? Because people will have to be making decisions in 2002, so we have to position ourselves in early next year to have the most important information and the best information we can to inform that decision. And there may be additional

work that continues to refine this and to better refine whatever that decision is, just as this fall, we're making information based on the best information we have available today.

And that gets to the second point which is from a regulatory decision making process, how do we deal with this and I would just point out that is it just Reg. Guide 1174 and we have a tendency when we think about 1174 to sort of focus on the quantitative aspects of that framework, but in fact, that's only one piece in there and if you look at the total five elements that need to be considered you need to consider traditional margins, defense-in-depth, monitoring and those other areas and we clearly will be taking those things into consideration with any regulatory decisions we make.

But again, getting back to this presentation, we need to get this technical work, we would like to put this into a 11174 quantitative framework as well early next year so that we can help inform the decision, so that's our goal.

MR. REINHART: And maybe Ed, we have a suite of regulatory guidance that is guiding us, obviously, but we're certainly open to be thinking out of the box and as we go along we're looking for

different ways to look at the data, look at the information, what's important, what's not important, so we're not tunnel vision, but we do want to work within not just 1174, there's a whole suite of guides that we have, and use that information as a place to start from the probabilistic aspects.

MR. HACKETT: I think as a kind of illustration of what Jack and Mark were just talking about, you look at -- kind of two ways you could go about looking at crack initiation. I've got them on the slide. Two sort of processes that have been discussed or postulated for how this would progress in a mechanistic sense are really what those first two bullets are up here. That would be the way you would like to go about doing this in a more purely scientific mechanistic way. I think, in fact, we're probably going to be severely limited in that regard by lack of data and other difficulties, so when you come to the bottom bullet there, what Dr. Shack has done is consider laboratory data, supplemented or form of laboratory data for some of what we're looking at in initiation space, sort of conditioned by consideration of time to initiation from inspection data which is more of an empirical approach for going about this kind of thing. But that's a good example.

I think the first two bullets there are something we could spend many master's theses and Ph.D. theses on exactly how these should be progressing. And as Jack pointed out, that's not what we're about.

CHAIRMAN APOSTOLAKIS: By the way, Dr. Shack's name has been mentioned many times this morning. This is Dr. Shack of Argonne National Laboratory, right?

MR. HACKETT: That's correct.

CHAIRMAN APOSTOLAKIS: Okay.

MEMBER FORD: Ed, on just a definition. Your definition of time initiation is the time it takes to get an environment in that annulus, is that correct?

MR. HACKETT: I might turn to Bill on this. My own definition -- I don't know that we've really gotten into discussion of that would be the development, that plus the development of I guess what I would call an engineering crack that would be hopefully discernible through the --

MEMBER FORD: For circumferential crack.

MR. HACKETT: Right.

MEMBER FORD: Okay.

MR. HISER: I think also what you would need to look at, is going back to the very beginning,

what is the crack that gives you the leak? Is it through the J groove weld? Is it an axial crack that goes through the wall?

MEMBER FORD: That's why I'm asking the question.

MR. HISER: There are several.

MEMBER FORD: What do you mean by --

MR. HISER: I think there actually several times that really are important. I'd include all of those.

MEMBER FORD: Okay.

MR. HACKETT: The other one in this area that's obviously already been discussed this morning, that's been contentious to say the least is the annulus environment. I think to sort of cut to the chase, I think we're in -- largely in agreement with the industry that this is hopefully a primary water environment for the reasons I state here. We don't know that for sure is the bottom line. But I think this is an area that's a tight crevice. It's unlikely to be oxygenated. Depending on where the flash point is when the fluid is exiting the crack that exists, if that's far enough away you're maybe not likely to concentrate as aggressive a species as we might otherwise and then the other thing is once these

cracks go through wall, they now have a communication with the primary water environment that's hopefully causing some flushing. This is key to the next slide because we are going on with the assumption that this would largely be a primary water environment. We don't know that.

I'll just move real quick through --

MEMBER FORD: Hold on. Before you do that, because this came up for a lot of discussion in the meetings we had in July where it was arbitrarily decided that there was a primary environment without any justification.

From what I understand, you can have pH as anything from 4.5 to 8.5 in that annulus.

MR. HACKETT: That's correct.

MEMBER FORD: And practically speaking, there's really no way that you can look at a specific CRDM housing and say the pH in that annulus is that. There's no way you can do it.

You have data, I assume, that shows that it doesn't really matter. Is that correct? On cracking susceptibility, you can go from 4 to 8.5, do you have data that shows, hey, this uncertainly doesn't really matter.

MR. HACKETT: Without a large impact for

Canal 600, I'm caveating this, in a primary water environment, that's correct.

MEMBER FORD: Okay, fine.

MR. HACKETT: But that's why, actually, starting with the next slide I said the first statement that I did there. The bottom line is we don't know exactly what this environment is. To cut to one of these, there is -- I don't know where I guess I had on the previous slide, the -- one of the considerations would obviously be to go find out. We discussed that with the industry that came up at the meeting yesterday to sample one of these environments.

MEMBER WALLIS: Can't you make some calculations what happens in that crack in the annulus?

MR. HACKETT: That has been done indeed. Dr. Shack has done that.

MEMBER WALLIS: I mean in terms of the fluid and chemical environment. Has he done that too?

MR. HACKETT: He's saying no.

(Laughter.)

So maybe not.

MEMBER POWERS: Why don't you get yourself a new contractor.

MR. STROSNIDER: This is Jack Strosnider.

I think there's some industry calculations that were done that were referenced in some of the work that Dr. Shack provided to us and is documented in the assessment report, but they were industry calculations.

MR. HACKETT: This comes down to then the next step is for crack growth. We're making the jump from the first one to the second one as Dr. Ford mentioned that the big jump there is that this is a primary water environment largely.

MEMBER WALLIS: Intuition would be that it can't possibly be, boiling off the water, leaving behind whatever else is there.

MR. HISER: I think it's described in the preliminary technical assessment, it may not be primary water initially, but as you get cracked opening and get additional leakage, there's enough communication with the bulk primary water. I think a lot of the --

MEMBER WALLIS: The water is continually disappearing by flashing.

MR. HISER: Initially, yes.

MEMBER WALLIS: It always is. You're not squirting out water into the environment. You've got a very dry environment on top of this crack.

MR. HACKETT: I think what Allen was coming to, Dr. Wallis is that once the communication is there through wall --

MEMBER WALLIS: I'd like to see -- it would be much more reassuring if someone would draw a picture to show that something else hasn't been done to justify these --

MEMBER FORD: I think what's becoming very obvious, Graham, is that we are not going to have the answers to all of these questions.

MEMBER WALLIS: It shouldn't be all that difficult to do some simple fluid dynamic diffusion, whatever is necessary, boiling analysis and get maybe some boundary estimates of what's there.

MR. STROSNIDER: This is Jack Strosnider. I just would comment that the technical assessment report that we just provided a few days ago actually has several page discussion referencing those sort of analyses, so there's a lot more detail in that report.

MEMBER FORD: I think from the point of view of this meeting, all we're trying to get is a feeling that we are moving forward on this whole issue, all the parts of the issue.

MEMBER WALLIS: I'm not feeling we're moving forward if we don't have some sort of analyses.

MEMBER FORD: Well, put it this way. I'm at the advantage, I've seen some of this data unofficially, and yeah, they are moving forward.

If we have another meeting, then we will be discussing all of these ins and outs.

MEMBER POWERS: I think we ought not underestimate the complexity of doing a simple quote diffusion analysis in a crack environment and it's because not only do you have multiple species reaching saturation, but you have an incredibly high electromagnetic field in the vicinity of this crack surfaces, that I'm not sure you would really have the ability to calculate things like diffusion coefficients and things like that in that relatively narrow crack.

You could put a diffusion coefficient in there for the ionic species, but I think you'd just be dead wrong.

MEMBER FORD: Dana, you could well be right. I'm trying to move this one on forward. Where I stand, anyway, at this point is that all the analyses I've seen you're between 4.5 and 8.5. That's four orders of magnitude of hydrogen ion concentration and you intuitively say that's going to make a big effect on cracking susceptibility. If you have data

and I understand there is data to show that you can go over that range and you're only going to change the crack propagation rate by a factor of two, then forget this problem for the time being. Forget it, and let's move on.

That would be my technical view. I think go back and revisit it later on. But if you're going to move forward, scrub that out as a major issue at this point.

MEMBER ROSEN: I'm having a great difficulty believing this is a primary water environment. Primary water is under 2000 pounds per square inch pressure. Clearly, that's not what's happening in this annulus. So just from that standpoint alone, it's not a primary water environment.

MR. HACKETT: I think that's what Dr. Ford was getting to and I know you guys will want to move on, but we talked about this yesterday for many hours and in fact, we could probably devote an entire meeting to this subject easily.

Maybe it's incorrect to be saying primary water, but maybe largely more that way than more concentrated, once the communication is there with the thru-wall crack. I think that's where we're getting

to.

To move beyond that, one of the things that's of interest here, if that is a problem, we have no data for that specific environment. What we do have a lot of data for and that's one of the good aspects of this slide is there is a lot of data for Canal 600 in a primary water environment from a lot of sources. There's significant variability in that data, but it's real variability. It's actually data that we have as Dr. Ford has pointed out. It's also appropriate, we think, to consider that variability on a heat basis as opposed to an actual per data point basis. The net effect of that is it expands your uncertainty bounds when -- because you have fewer numbers of heats than you have total data points.

The overall problem is complicated by consideration for multiple initiation sites. You could account for this in several ways. At least one way is that you're multiplying your crack growth rate potentially and we certainly have seen the crack growth rates in excess of units per year are possible for this type of phenomenon.

In terms of the stress state, I think this is an area where we're still developing some details on some of the inputs. I think the ones that are

fairly straight forward, the first bullet are stresses due to primary pressure and crack face pressure. However, the primary drivers in this particular phenomenon are really residual stresses and I've tried to summarize some of the sources there, the main source being welding. Any time there's a welding process, there's potential for leaving up to yield level residual stresses from that process. This is also a complicated manual weld which is done in a -- it's basically a helical sort of situation. The fabrication processes and sequences can change the residual stress state or affect it significantly. The installation procedures for the penetrations themselves can result in residual stresses from straightening or bending that might have occurred when they were put together.

Modeling details can be fairly critical in how many passes are being modeled. If you're looking at finite elements to try and figure out what the residual stress state is, how many elements do you need to go through the thickness there to get the refinement that you need. And there's been -- the industry has done some work in pointing out the influence of thru-wall strength gradients that looked to be a factor at Oconee, for instance, with shifting

the primary stresses, the larger stresses to the outer diameter of the penetrations.

There's also -- these are the first two bullets are ones that have been considered so far in the analyses that we're aware of that we've done and that the industry has done. Dr. Wilkauski has pointed out the two bottom sources that really haven't been considered thus far, that we're looking at, addressing in the analysis that the NRC is sponsoring. One is differential expansion at the root of the J-groove welds. You know, we've talked about and the industry I think has demonstrated pretty convincingly that there's a separation when the plant is under pressure and heated up between the penetration and the head itself.

That's a good thing from the perspective of leakage, but what it does for people who are familiar with fracture mechanics, it induces basically a crack tip opening displacement at the bottom where the bottom of that annulus where it's joined to the J-groove weld. We haven't really assessed the driving forces from that.

There's also potential for a contribution from cyclic thermal stresses. That was discussed yesterday at the meeting that we had with the

industry. Dr. Scott made some comments on that in terms of this may not be a principal driver for like fracture mechanics, but it may have the effective breaking of film in terms of the film rupture model or it may have initiation impact on the initiation. Anyway, these are considerations that we still need to address.

MEMBER FORD: On the residual stress aspect, I know you can do a whole lot of finite analyses to determine what these could be. Are there any qualifying measurements?

MR. HACKETT: Not that I'm aware of. I turn that to --

MR. HISER: Maybe somebody on the industry side could speak to that a little more.

MR. PATHANIA: I'm Raj Pathania from EPRI. I'm working on MRP project. AS a part of this problem back I think about 7 or 8 years ago, measurements were done on CRDM nozzles in France and then those measurements were checked against the finite element stress residual stress models and there was reasonable agreement. There's a published EPRI report on that and we can provide that report if anyone is interested in that. There was reasonable agreement both with the residual stress measurements and the fact that when

you weld these things, the tube goes over because of distortion and so the ovality measurements themselves are a reasonable way to check out your models.

And in addition, I believe Westinghouse has done some measurements also on the CRDM nozzles.

MR. BANFORD: Yes, this is Warren Banford from Westinghouse. We made some measurements of the ovality, of the tubes below the head. Because of the weld, being on an angle, what it does it makes the tube go from circular to oval and we used finite element results that we got that we were using to predict residual stresses and we used those results, the predictions of the ovality and check with the actual ovality that had been measured in the field of tubes in that particular position and we found very good agreement. So that was the way that we bench marked our finite element work, in addition to the French work which was further confirmation.

MEMBER FORD: And the stuff that you were talking about was primarily x-ray?

MR. PATHANIA: No these are strain gauge measurements.

MEMBER FORD: Strain gauge, okay.

MR. HACKETT: And moving on to address structural margins. Obviously, there's a need -- one

of the bottom lines of the analysis is Professor Apostolakis was getting to earlier is maintenance of appropriate structural margins. Where we are with this is obviously with a PFM analysis, the intent would be to perform this on a best estimate basis. In fact, what the second bullet goes is that at this state of development we have enough uncertainties in this that we're addressing that if we had to try and assemble this right now we would need to be adding margins in certain elements to address these uncertainties. This is not the way you want to do this type of analysis. That's where we would be right now.

What we're hoping to get to is obviously a greater level of refinement that we don't need to do that. But in this case we had to do it, where to apply the margins and what the magnitudes would be problematic.

CHAIRMAN APOSTOLAKIS: Is this where you disagree with the industry or do you disagree at all? We heard earlier there was an estimate of delta CDF and so on that you have not examined yet, the calculations. But is it a disagreement here somewhere?

We are being presented with programs that

will calculate this and that, difficult problems and so on, but in terms of real decision making in the next few months, is there a disagreement somewhere?

MR. STROSNIDER: This is Jack Strosnider. Let me interject this thought and with regard to some of the plant-specific information you heard earlier and we received that evaluation within the last week and it's under review by the staff now. I think the plan is to meet on it next Tuesday and to go into some of the detailed discussions, so that review is in process.

I think from the generic point of view and from the development of this technology I don't' think there's disagreement. There's technical issues that we need to share information on industry and NRC to make sure that we come up with the most reasonable and appropriate models to do this. That's really what the purpose of putting out the preliminary technical assessment document was, so that people -- the industry and others could see where we're at in terms of this assessment. And if there's information that can be brought to bear, if there are some assumptions or way we're interpreting information that people think is incorrect we want to hear it and we want to work that. So I think if you get down into some of

these specific technical areas, there's certainly room for discission. If you want to call that disagreement, maybe there's some issues that need to be worked out, but that's the process we're working through in terms of trying to develop this model.

MR. HACKETT: For the bottom line of where we're heading for this and where the technical assessment goes right now, is looking at the impact and Larry Mathews covered some of this earlier, inspection methods and particularly timing. This goes to -- we had a lot of debate yesterday over when do the cracks start and how fast are they growing.

Certain inspection methods for this type of phenomenon have been quote unquote qualified. One per the Bulletin is this qualification for leakage that was discussed earlier by the industry with the idea that you have the leakage path and you do have an access to the bare metal that you can make the determination.

The other one is the previous phenomenon back in 1997. There was an approved methodology for using Eddy currents inspection technology for looking at ID cracks on the penetrations themselves.

Moving down further, there are other methods that really remain to be qualified and I guess

clarification is probably needed there and qualification in this case, I was probably looking at as an ASME PDI type qualification performance demonstration initiative, where you're looking at qualification of both methods and personnel to be able to detect and size some of these type of defects. And in that case, you're looking at probably both surface and volumetric exams through the J-groove welds, also volumetric exams for the vessel head penetrations and being able to shoot through that wall to look at OD cracking.

Bottom line there is that the determination of the appropriation inspection intervals from PFM will obviously depend on the reliability and effectiveness of those inspections to at least some degree which is really -- remains to be determined.

Allen is going to go into some more of this in detail, but just in terms of the tech assessment, but just to sort of summarize where we've been going, this has really been -- this is RES initiatives on reactor vessel head penetrations. It's very much really been a team effort at NRC between RES and NRR and the research contractors to developing an integrated technical perspective on this, largely

using a probabilistic fracture mechanics construct.

As I mentioned, the conclusion at this point is that the development so far indicates that there is some key inputs that are lacking appropriate data and/or are highly uncertain and some of that we may be able to do some things about. Some of it may be just what we're going to have to live with, that the current state of development of these uncertainties do limit the ability of this type of assessment to do a lot for you. And we're hoping, obviously, that the continued efforts in this area are going to result in reductions in these uncertainties and make this a more viable methodology for assessing the overall impact of this phenomenon in the future.

MEMBER ROSEN: Is this a separate, or a scientific search for truth or is it an attempt to ultimately be able to apply these techniques to plant specific situations?

MR. HACKETT: I guess we like to feel that we're always looking for the truth in terms of the research aspect of the thing. But I think the answer is really more the latter, because I think we could be searching for the truth for a long time, probably at least the rest of a lot of careers that I can think of and in this case, we have some real practical problems

to come to grips with near term as Jack was mentioning earlier.

So I think it's really going to be more the practical lean and there will obviously need to be compromises along the way in that regard.

MEMBER FORD: But my earlier question, you are planning by say early spring of 2002, you will have a defensible disposition algorithm?

MR. HACKETT: That would be the --

MEMBER FORD: That would be either deterministic or probabilistic.

MR. HACKETT: That would be the goal and then to have -- I think what we have now is Dr. Apostolakis asked about agreements, disagreements. I think with the industry and the NRC, I think there's fairly wide agreement on the elements that need to go into this thing.

MEMBER FORD: Right.

MR. HACKETT: I think you've seen that today. I think there's just really a question on some of the key input varies in discussions over uncertainties in those. But I think the construct is there, and I think the answer is yes. Hopefully we'll be in a position.

MEMBER FORD: And so that will have an

effect, not on inspection periodicities, but it will also have a feedback into the completeness, if you like, of the prediction algorithm that you're currently using for privatization of inspections?

MR. HACKETT: That's correct.

MR. STROSNEYDER: This is Jack Strosneyder and I'd just comment with regard to the practicality of the work, and I think Allen's going to present, if we get through, the material that he has. If we get toward the end of that, there's some curves that are in the technical assessment documents which were intended to present the results of the work done so far in a format such that it could be help to inform decisions, recognizing that there's uncertainties and it's not the best model for doing that because there are still uncertainties we need to deal with.

But we're trying to put this work into that framework so that it can be used to inform those decisions.

MEMBER FORD: Well, we've got to see those graphs. I love graphs and we're going to do it by half past 10:00, so let's do it Allen.

MR. HISER: Let me ask your guidance.

MEMBER FORD: Get rid of all the pictures.

MR. HISER: No pictures?

MEMBER FORD: Yes, pictures. Okay, I'm kidding.

MR. HISER: There are two parts of my presentation. One is the preliminary staff assessment that you've had some time to look at. The other is more an overview of the inspection findings and some photos of some of the visual exam results.

MEMBER FORD: Fine.

MR. HISER: Which one would you like me to start with?

MEMBER FORD: Provided that you'll promise me that we'll see some actual graphs.

MR. HISER: Okay, you'll see some actual graphs. They may be short of background and we'll jump to graphs.

MEMBER FORD: Right.

MR. HISER: The first thing I'll start with is just an overview of the bulletin very briefly, the status of the inspections and things, and the status of our understanding at this point. When we spoke to the committee, in I believe it was July, we were talking about a proposed bulletin. The bulletin was issued in early August. We did ask questions of all plants related to the plant specific aspects of susceptibility, the number of nozzles, things like

that.

We were looking at what is the type of insulation on the head as it relates to the ability to do visual inspections, and also that's more the inspection side. We also were asking what are the consequences and what structures, cabling, things like that are above the head that could be damaged if a nozzle were to become ejected.

For plant specific consideration, we did have questions related to the susceptibility of each plant, specific questions if they found cracking or leakage, what the extent of that was, what their plans and schedules for future inspections were, and then also how those plans would meet the regulatory requirements. That's just a brief overview of the bulletin.

Within the bulletin, we speak of a graded approach to doing examinations for plants that have varying levels of susceptibility to cracking, or have a history of cracking. We think that it is appropriate to do different examinations. The bulletin speaks of an effective visual examination, and effectively what that is, is that you have access to the bare metal where the nozzle intersects the head and you can detect boric acid deposits. That assumes

there's no insulation in the way, no other impediments, that there are no other boric acid deposits in all honesty. It's hard to differentiate one from another.

So that would be, I guess if you will, the lowest level of examination. The next would be a plant specific qualified visual exam that's been mentioned before. That's a plant specific demonstration that you have a leak path, such that if you get a leak in the J-groove weld, that there is a way for deposits from that leak to come up to the head. Then you can detect through an effective visual examination.

The last inspection that's discussed in the bulletin is a volumetric exam and this one, again, is focused on the outside diameter of the nozzles to detect circumferential cracking at that point.

MEMBER WALLIS: Does what you see give you any indication of how far the crack has progressed? If you see great big balloons of popcorn, that's going to tell you something that's different from just little clusters of popcorn?

MR. HISER: Within the results that we have to date, in particular going back to the Oconee 3 results, we had 165 degree through-wall crack

circumferential. There doesn't seem to be any relationship to amount of deposit in extent of cracking.

MEMBER WALLIS: Okay.

MR. HISER: Now, the bulletin responses came in in early September. The bulletin does bin the plants into four groups. The first is those that have exhibited cracking or leakage. That's five plants all together. The other three bins, if you will, are based on the relative susceptibility ranking. In each case, the bulletin provides some suggestions on what would be an appropriate inspection for each bin.

In particular, for those plants that have found cracking or leakage, the bulletin suggests that a qualified volumetric exam should be performed by the end of 2001. Upon looking at the responses and additional consideration of things, what the staff has accepted is a qualified visual exam at the last outage as being a sufficient inspection method.

As you can see, as you go down in susceptibility, there are sort of reductions in intensiveness of the inspections. The staff has addressed clarifications to some of the bulletin responses with specific licensees, and numerous licensees have provided either revised or supplemental

bulletin responses. We're still actually reviewing a lot of that information. As Jack mentioned, some of it just came in earlier this week.

Now looking at the plants that have performed their metal visual examinations, in all cases except one these are plants that are either in the high susceptibility bin or have exhibited cracking or leakage at some point. The one exception is Crystal River Unit 3.

What I'd like to indicate first of all, of the ten plants that have done their metal exams within the last twelve months, nine of them have come up with at least relevant visual indications and that really is the case for North Anna Unit 2. It's the reason that their number's in parenthesis. Those are visual indications that they're doing additional examinations on.

The other eight plants have confirmed cracks in the nozzles, in some cases, circumferential cracks. At Oconee Unit 3, Oconee Unit 2 and Crystal River 3, a number of nozzles have been repaired. There are a number of nozzles that have been left in service with axial cracks at this point.

VICE CHAIRMAN BONACA: The bottom line here is you say that those plants at the bottom, Beaver

Valley 1, et cetera, et cetera, have completed effective visual examinations. How do they differ from bare metal?

MR. HISER: These are the plants that are in either high susceptibility --

VICE CHAIRMAN BONACA: Okay.

MR. HISER: -- or had previously had cracked or leaking nozzles of the top, including Crystal River 3 in that population. That's thirteen plants all together, so ten of them have looked, three have not. Nine of them have found at least relevant -- eight have found cracking. Robinson is the only plant at this point that has not found any evidence of --

VICE CHAIRMAN BONACA: So the effective visual examinations on the bottom means bare metal visuals?

MR. HISER: Right. Right, they have not done the analysis to show that leaks would put a deposit on the head.

VICE CHAIRMAN BONACA: Okay.

MEMBER FORD: Allen, as you look at -- put the next one up. As you look at those, do you have any comments on the question I asked Larry? Can you draw anything from this information about the

difference between Babcock and Westinghouse reactors in terms of susceptibility, or is it purely a function of time at 600 plus or minus 2?

MR. HISER: I think it's too early to say. The one comment that I can make, one observation, seven BNW plants exist in the PWR population. Six have looked and found cracking. Three of the six have found circumferential cracking. At this point, we have not seen circumferential cracking in Westinghouse plants.

But then again, the intensity of the examinations has not been as strong as the BNW plants. That is what the bulletin was trying to get to, trying to increase the level of inspection so that we could determine whether there are any particular groups that are more problematic in this area.

MEMBER FORD: Now, I've heard it said that, maybe comment on the accuracy of it, that Babcock seemed to have been using more susceptible heat for whatever reason, and we don't know how to define susceptible physically. Could you comment on that? Is there any basis for that or not?

MR. HISER: I would say that we really haven't looked at it to that level of detail. We have, the industry has identified cracking in at least

one Westinghouse plant. That plant is doing repairs. We really have not assembled the data and been able to try to look for those kind of conclusions.

MEMBER FORD: Okay.

MR. HISER: I think the one comment that I'd make on the -- and this is very similar to Larry Mathews' graph, just a little bit different colors I think, different color scheme. The plants that are highlighted in the red circles have identified cracking recently. The one plant, North Anna 2 has indicated maybe that will end up turning into a blue square.

The bulletin made a distinction of 5 EFPY. The plants to the left of that were high susceptibility. Those to the right were considered to be moderate susceptibility. I think that the results generally support that. The one plant in this area that the bulletin maybe didn't designate properly is the next plant in line.

MEMBER FORD: Crystal.

MR. HISER: That's right. Crystal River identified a circumferential crack. So the circumferential cracks are here and here. It seems to sort of span the --

MEMBER FORD: But the ISI 5 is purely

arbitrary?

MR. HISER: Absolutely. Yes, the 5 was just a first cut at trying to provide some data that would be useful to look at. At this point, one plant in the high susceptibility zone has identified no cracking. Two at this point have not performed a recent ISI. But it does appear that these are the plants that are more susceptible.

As time marches on, you know, red circles will begin to populate out here. This one plants was included in the first bin of plants that have a history of cracking, because I identified axial cracking in 1994.

So my conclusion from this, susceptibility ranking is working as intended. I mean, we don't have any plants that have identified cracking at 20 or 30 EFPY. So, that's a good sign.

MEMBER POWERS: At 20 or 30?

MR. HISER: EFPY from Oconee Unit 3.

MEMBER POWERS: Have they looked?

MR. HISER: Some plants have looked using the effective visual exam. They've looked at the bare metal on the head and have identified no relevant deposits. These are two plants, Kewaunee -- the other two plants, I believe the one furthest out is about 22

EFPY from Oconee Unit 2.

MEMBER POWERS: How long from the time a crack exists to the time you can find deposits?

MR. HISER: I think an expectation is that from the time that you get a through-wall crack in a J-groove weld, that the time to see the deposit is hopefully less than the time to initiate a circumferential crack. We don't have any firm data in that regard.

Unfortunately what we're, you know, the bulletin was information gathering. We wanted to try to find out the population of flaws that are out there, how severe is the problem. What we're ending up with is a population that's sort of one-sided. If you find a leak, you do additional inspections. If you don't see a leak, you don't do anything. And we're not sure if that, you know that clearly doesn't cover the full range of possibilities in terms of behavior.

Moving on from there, I just wanted to show some of the typical visual examination results from this fall. In both of these cases, cracks were identified in the nozzles and so these would be classified as leakers in a classic sense.

For this one as well. I don't know if you

-- let me show this next one. This is sort of the classic popcorn appearance that the industry speaks of in this area. This is what we've seen at Oconee Unit 3 and Unit 2 and ANO 1. That's sort of the classic deposits. In this case, I think this is easy to tell that you have popcorn deposits. On some of these others -- How do you interpret that? Is that a relevant -- is that popcorn? Is that a relevant indication?

CHAIRMAN APOSTOLAKIS: When you say "that", that is that?

MR. HISER: These deposits.

CHAIRMAN APOSTOLAKIS: That's just -- okay.

MR. HISER: It clearly isn't just bare metal with the nozzle coming into the head. I guess we don't have any on that one. But the industry has treated nozzles like this in general as relevant visual indications, and they've done additional exams, volumetric surface exams. I think they have in general done a very good job of following up indications like this.

The interpretation the industry has tended to put on this is they do not call this a leak until they confirm that through volumetric or surface examinations. The difficulty comes in when you get

things that look like this.

MEMBER ROSEN: Would you go back to that prior one.

MR. HISER: Sure.

MEMBER ROSEN: Because it just seems to me so clear what's going on here. I'm sort of puzzled by you not saying it. That looks to me like a very old leak that may have somehow dried up. Clearly there's damage there. It's not normal. It's not the way it was built.

MR. HISER: One of the problems that many of the plants have is they have leaking CRDM flanges, CONO seals and canopy seals, and that provides boron on the head, differentiating is it from the nozzle, from under the head leaking out, or is it from an external source, is part of the difficulty in interpreting the visual exams.

What the industry has consistently done is to say, this required more attention. They're not sure if it's from a leak in a nozzle or from an external source, so they've done additional exams to try to determine the source.

This is the next one that I put up. That looks similar to what we saw at Oconee and the early graph that I showed. The problem though in a case

like this, is trying to find where the crack is so you can fix it. And, in some cases like this and also with this nozzle, this is the same nozzle. These kinds of indications in that area are sort of ambiguous.

In the case of this nozzle, the licensee did extensive ultrasonic and surface exams, found no leaks, no surface cracking, no source of deposit. The conclusion that they reached and that we agreed with, was that this came from an external source, in this case a CONO seal leak.

What I wanted to do is just give you a flavor for the kind of visual examination results that we're seeing and having to interpret. I think overall, the industry has done a good job in following up relevant deposits.

MEMBER ROSEN: Would you go back to that for a moment?

MR. HISER: Sure.

MEMBER ROSEN: Why would you say that's a CONO seal leak? Wouldn't you expect to see some evidence of it coming down from above? And yet, that penetration looks perfectly clean to me above the area that you indicated.

MR. HISER: And in the case of this

licensee, and I think again we're finding a lot of variations from plant to plant. This licensee has a very high air flow rate through the upper head area, and the CONO seal leak deposits don't drop straight down, but they're blown every which way.

Looking at videotapes of this head, you can see on some nozzles where there are streaks along the side of the nozzle, so the leakage comes down vertically, gets caught up in the air flow and is blended horizontally. There tends to be boric acid in many placed on the head. It tends to be fairly well localized, but it's not -- I think one could -- look at this case.

MEMBER WALLIS: The only place we see it in that picture is where you would see it if it came out of a crack.

MR. HISER: The deposits back here?

MEMBER WALLIS: Yes, that bottom one.

MR. HISER: You really have to see the videos to get a full appreciation for this, but there tends to be a lot of boric acid. This does not look like the popcorn appearance that we've seen classically with the circumferential cracks in particular. This has been followed up with additional exams. No relevant cracking has been found.

MEMBER WALLIS: It could mean you don't do a good job of finding cracks.

MR. HISER: The inspection methods have been qualified with service cracks. Clearly, there's a chance that that has happened as well.

MEMBER FORD: Could I suggest we move on

Allen? MR. HISER: Sure.

MEMBER FORD: I recognize that are scuppering you here, but looking through here, there's a lot of good information at the back here that I want these gentlemen to be exposed to. Now, do I understand that we are allowed to go to a quarter to 11:00? George?

CHAIRMAN APOSTOLAKIS: I'm sorry?

MEMBER FORD: Can we go until quarter to 11:00?

CHAIRMAN APOSTOLAKIS: No. I'm sorry. We have an absolute deadline of 1:30 with the commissioner coming.

MEMBER FORD: 10:30?

CHAIRMAN APOSTOLAKIS: So I can't move things.

MR. HISER: How would you like me to proceed. I can jump to the bottom line more?

MEMBER FORD: Why don't you jump to the

bottom line if we must leave at 10:30. It's obvious, I think, that we're going to be having another full day meeting sometime.

MR. HISER: Let me speak a little bit to one of the areas of contention yesterday in our meeting. The crack rate is an area that we don't have alignment if you will between the industry and -- at this point in time. This is some data for Alloy 600. The top curve illustrated here is what would be called a 95/50 confidence bound on the data. The curve at the bottom I believe is a 50/50 analysis of a larger bulk of data.

What the staff has used in its preliminary assessment is a 95/50 curve as an upper bound. In addition, we have defined what I would call a high mean value. What has been seen and has been hypothesized is that the heats of the material that are going to crack are the ones that are most susceptible.

So instead of looking at the full population of data, one should really concentrate on the upper half of the data. We've defined a high mean as the square root of the product of the 95/50 and the 50/50 data, so it would be a curve that lies essentially in between. In this case, I think it --

MEMBER FORD: From where you stand right now Allen, if you were asked what disposition curve do I use, would you choose the 95/50 or the 50/50, and what would the industry want to do?

MR. HISER: I won't speak to what the industry would like to do. My guess is that, well what we recommend in the technical assessment is a 95/50 curve.

MEMBER FORD: Good.

MR. HISER: I do not believe the industry would recommend the same curve.

MEMBER WALLIS: Where is K for your situation here on the picture?

MR. HISER: For the nozzles, we are generally in the range from 30 to 50 or 60 MPA root meters.

MEMBER FORD: And I'm reminded there's a second. There's a centimeter in 100 days. It's called insignificant.

MR. HISER: The difference from the 50/50 to the 95/50 is about an order of magnitude.

MEMBER FORD: Yes, but the top line is not an insignificant crack. It's pretty rapid.

MR. HISER: No, it's about an inch, 30

millimeters per year on that order.

MEMBER FORD: That's right. So again to come down to the bottom line where you stand right now, unless there's other information that comes available the next two months, you have been suggesting an inspection periodicity based on that 10(-9) meters per second rate?

MR. HISER: Based on the 95/50.

MEMBER FORD: Yes.

MR. HISER: And that puts you in that sort of a crack root.

MEMBER FORD: PWR environment?

MR. HISER: Yes.

MEMBER FORD: In the PWR environment.

MR. HISER: Now there was a little bit of mention earlier about the annular environment, what is correct? Is PWSCC really an accurate way to characterize what's going on in the environment? The technical assessment indicates that if there are any upset chemistries in the annulus, the effect on crack root may be up to a factor of 2. I think maybe the 95/50 is one interpretation of it, is that it would account for things like that.

Looking ahead to Slide 17, the staff has looked at deterministic and probabilistic assessments

and there's discussion of both of those in the preliminary assessment. The parameters that we've used are here. I think the numbers are not in substantial controversy on critical flaw size, about 270 fora factor of safety of 2 or 3 on pressure; 342 is what our analysis indicates for nozzle failure and possible ejection.

As I mentioned for crack growth rate, we're using a 95/50 statistical bound. We're looking at a temperature of 318°C for this conditions. You get an A for the Scott Model as indicated there. For the initial flaw size, we really don't know what the flaw size is. Without inspection data, it's hard to draw conclusions on a plant specific basis.

In lieu of that, our deterministic assessment uses a range of initial flaw sizes to see what the effect of that is. In terms of uncertainty and sensitivity studies, we've looked at different statistical bounds to the crack root data, the effects of temperature and again, we're using an initial flaw size as a parameter.

CHAIRMAN APOSTOLAKIS: I was just informed that Commissioner McGaffigan is willing to come a little later. So, you can have your fifteen minutes of glory.

MEMBER FORD: Thank you George.

CHAIRMAN APOSTOLAKIS: Thank the commissioner.

MEMBER FORD: There's a lot of stuff here.

MR. HISER: This is an illustration of the K that we're using as a function of crack half length. It peaks at about 60 KSI root inches. This area is principally due to residual stresses, mainly from welding on the tail end of the curve is due to pressure stresses, and we've tried to model as best we can at this point in time what the K range or K curve would look like for the nozzles.

We talked about crack sizes. Thus far, five circumferential cracks have been identified through inspections. The first two were verified through destructive examination. The last three have not. In particular, I guess what I'd like to point out, the one destructively examined crack of 165°, the ultrasonic record indicated an inside diameter extent of 59°.

So clearly, there's a lot of uncertainty on the ability of the ultrasonic method to size these cracks. But it would be very helpful from an analytical standpoint to have some sort of confirmation of cracks that occur in the future,

instead of just the machining the cracks away, some way to confirm the size of those would be very helpful.

For the base case, again 318°C, 95/50 crack growth curve. That's illustrated here as a function of crack length. The maximum growth rate would be about 1 3/4" per year down to about ½" per year.

MEMBER FORD: Allen, could I presume just to tell you what to do, because I want to make sure --

MR. HISER: Sure.

MEMBER FORD: -- all the members have time to ask you questions. There's a tremendous amount of work here. Could I suggest maybe you discuss Slide #27.

MR. HISER: Okay.

MEMBER FORD: I'm really interested then to hear the bottom line on your inspection and what the next staff plans are.

MR. HISER: Okay.

MEMBER FORD: And then that would give time for all the members to ask any closing questions.

MR. HISER: Now, as a part of the uncertainty and sensitivity study, we have looked at temperature and statistical bound to the crack growth

data as parameters. What is indicated here is the operating time from an initial crack length to the nozzle failure, nozzle ejection, crack length. We have different crack growth curves. As an example, the 318°C bound curve would be at that temperature. The 95/50 curve, the curves marked as M are not the 50/50. It's a curve that's between the 95/50 and 50/50 curve, so it's more of a high mean value.

As you can see, there are affects of temperature. If you go from 325°, 318° to 315°, reducing the temperature increases the operating time to failure. More substantially, I think, is the effects of statistical bound, if you go from a 95/50 to a mean curve, you get very substantial changes.

CHAIRMAN APOSTOLAKIS: When you say 95/50, what do you mean?

MR. HISER: That means there's a 50 percent probability that you've bounded 95 percent of the data. That's 50 percent confidence that you have 95 percent bound. As an example, the 95/95 would be 95 percent confidence that you bounded 95 percent of the data.

Using the 318° bounding curve, the 95/50 curve for flaw sizes smaller than 120°, you would have at least four years before you would reach a critical

flaw size.

MEMBER FORD: Could you just comment on what you call the industry crack growth rate?

MR. HISER: The industry crack growth rate curve is 10 millimeters per year. I'm not sure the -- this came to us in at least one submittal and I think is more of a mean curve or maybe below mean overall.

MEMBER FORD: So obviously as we move into the future, there's going to be a lot of discussion between you and the industry as to which one of those curves is appropriate for a specific plant?

MR. HISER: Yes, clearly one of the ideas is that depending on the level of inspection could impact which of those curves would be appropriate for the plant to use.

CHAIRMAN APOSTOLAKIS: Let's see, all of them start at 300 and something degrees.

MR. HISER: Right, 324.

CHAIRMAN APOSTOLAKIS: What is that now?

MR. HISER: Okay, what this means, if I have a 60°C to start with and I'm using the 318°C 95/95 curve.

CHAIRMAN APOSTOLAKIS: Oh.

MR. HISER: It means I would grow to failure in about eighteen months.

MR. Leitch: 324 is four phase.

CHAIRMAN APOSTOLAKIS: Okay, and the confidence you're referring to comes from the percentage of the distribution on a number of parameters of going to the mother, right?

MR. HISER: In this case, it's totally on the crack growth rate.

CHAIRMAN APOSTOLAKIS: Oh, just the crack growth rate.

MR. HISER: This only has crack growth rate as a parameter. That's the only thing that we're varying in any of these curves.

CHAIRMAN APOSTOLAKIS: Right.

MR. STROSNEYDER: This is Jack Strosneyder. I'm glad that point came up because I wanted to make it. There's one random variable in the plot you're looking at here, and that is the growth rate for circumferential cracks. All right.

When we talked briefly about some of the other uncertainties with regard to what the stress levels are and certainties in the inspection and what might be left in service after inspection and those sort of things, that's not reflected in this analysis. Those are the things we need to develop in order to come up with the full probabilistic assessment.

CHAIRMAN APOSTOLAKIS: The random variable is the operating time to failure.

MR. HISER: That's right.

CHAIRMAN APOSTOLAKIS: And the others are the uncertainty variables, and so far you have used only the crack growth rate.

MR. HISER: That's the one variable that we have sufficient data on that we feel we can do the sort of analysis.

CHAIRMAN APOSTOLAKIS: So, if I pick one value of the crack growth rates, say the 50th percentile, the median, what kind of a distribution have you assumed for the operating time?

MR. HISER: That's what this curve shows you that the median's plotted on there and you can look at --

CHAIRMAN APOSTOLAKIS: No, there's no one curve. I mean, you're down horizontally.

MR. STROSNEYDER: Al, explain the 95/50 where that's at for a 315 center. Let's just pick that because it's an easy color.

MR. HISER: This would be a 95/50 representation of the crack growth rate.

CHAIRMAN APOSTOLAKIS: When you say "this"?

MR. HISER: The green curve.

CHAIRMAN APOSTOLAKIS: Okay.

MR. HISER: The green curve.

CHAIRMAN APOSTOLAKIS: Okay, 95/50. So this is the 95^{th} percentile on the operating time, using the 50^{th} percentile for the crack growth rate?

MR. HISER: No, this is a deterministic calculation. We take the crack growth rate that correlates to a 95/50 bound on the crack growth data.

CHAIRMAN APOSTOLAKIS: Which is a 50 percent confidence.

MR. HISER: For each crack size, how long it will take to grow to the failure, to the nozzle failure crack.

CHAIRMAN APOSTOLAKIS: So this is not the 95^{th} percentile of the operating time?

MR. HISER: No.

MR. STROSNEYDER: No.

CHAIRMAN APOSTOLAKIS: Oh.

MR. HISER: The 95^{th} percentile on the crack growth data.

MEMBER WALLIS: In the reactor environment.

MR. HISER: Assuming a primary --

CHAIRMAN APOSTOLAKIS: What is the 50 then?

MEMBER KRESS: It's the mean value of the 95 percentile. The distribution is about how well you

know the 95 percentile, and this will be the mean of that distribution.

CHAIRMAN APOSTOLAKIS: Do you have a distribution on the crack growth rate?

MR. HISER: Yes. It's humongous.

CHAIRMAN APOSTOLAKIS: That's one distribution.

MEMBER POWERS: It is an estimated distribution on that and yes on confidence on how accurate his estimate is.

CHAIRMAN APOSTOLAKIS: So that's what my second question was. It's not one distribution then? You have a family of distributions, each one with a different degree of confidence, is that it?

MR. HISER: Yes, that's correct.

CHAIRMAN APOSTOLAKIS: So you don't have a -- okay, so you don't have any other uncertainty coming into the calculation of the operating time.

MR. HISER: Right, and if you assume effectively a mean value of the crack growth rate, you would predict very long operating times to failure. If you assume a statistical bound 95/50, then it brings it down substantially.

CHAIRMAN APOSTOLAKIS: So the mean value then of the crack growth rate is on the relatively low

side, right? That's what you're saying?

MR. HISER: Yes.

CHAIRMAN APOSTOLAKIS: And then you have a long tail?

MR. HISER: Right.

CHAIRMAN APOSTOLAKIS: And the fun begins when you move onto the tail.

MR. HISER: Absolutely. And the philosophy that went into the assessment is, which nozzles, which materials are going to fail in service? It's probably not the mean values we're concerned about. The materials that are more sensitive, where the cracking would be more aggressive in the material. So from that standpoint, like a 95/50 curve is more appropriate from a philosophical standpoint.

MEMBER POWERS: I mean, I appreciate it.

CHAIRMAN APOSTOLAKIS: I don't understand it.

MEMBER POWERS: The qualifying statement, why not on a 95/95?

MR. HISER: At this point, I think that may be too extreme.

MEMBER POWERS: What I'm trying to understand is how do you decide?

MR. HISER: It's pretty much engineering

judgment.

MR. STROSNEYDER: I would interject two thoughts on this. One is -- this is Jack Strosneyder. One thing when we look at the data, and Allen had put the plot up before and remember that it's on a log plot, so there really is a lot of variability, right. But the other thing that comes into play here on these confidence levels is that when you do this by heat, there's a relatively small number, I think it's 20, 18 or 20.

MR. HISER: 11, it's actually 11.

MR. STROSNEYDER: So of course the confidence amount is driven by the amount of data that are available too, so we want to capture what we think is the real variability in these data, all right. But on the other hand, if you recognize you're dealing with a small amount of data and you use those high confidence levels, you can drive yourself to some very conservative values. So, that's one way of looking at it.

MEMBER POWERS: I understand that. I just am trying to understand what goes into the engineering judgment, that 95/50 is okay but 95/95 is too extreme.

MR. HISER: I think what we've seen so far is that the 95/50 operates as an effective upper bound

to the data.

CHAIRMAN APOSTOLAKIS: So what is up curve now, 95/50? Is it there?

MR. HISER: It's the ones marked B.

MEMBER POWERS: But if I looked at the data, I think in your 95/50 curve, I think I can find a data point. I better be able to find a data point that's above it.

MR. HISER: That's correct

MEMBER POWERS: So the 95/95 would be even a better upper bound to the data.

MR. HISER: Correct.

MEMBER POWERS: I'm just trying to understand your engineering judgment. I don't doubt your engineering judgment. I'm just trying to understand exactly how it comes out.

MEMBER FORD: If I could interject here. Allen, I apologize for asking to put this slide up, because it's started a whole lot of questions.

CHAIRMAN APOSTOLAKIS: That's why you got 15 minutes.

MEMBER FORD: But if the members just look at Chart 31, you can just see overall what the staff are planning and on that basis, I'd like to go around, remembering that his meeting, the objective of this

meeting is merely to inform the full committee that things are moving forward and it's very obvious things are moving forward.

CHAIRMAN APOSTOLAKIS: I mean, that's an interesting point. Let's go back to that. In documents like Regulatory Guide 1174, there is some guidance. It says "use the figure with the bounds and the limits using the mean value" but as your mean value approaches some limit, there is increased management of tension, which means now you're looking at the tail, how much probability there is above the limit, and you know, you start sending RAI's.

Why can't we apply the same philosophy here. Instead of saying we have to select the 95/50 or the 95/62, apply some consistent approach and say, you know, maybe I'll go with the mean but then when something happens there will be increased management attention.

MR. STROSNEYDER: This is Jack Strosneyder. I just point out an application of this information, it's been pointed out there is only one random variable that's considered in this, and clearly some judgment needs to be involved in how you take this information and apply it on plant specific discussions. And recognizing, not only how we're

going to treat this random variable, but recognizing that some of those other variables and uncertainties are not yet included in the analysis process, which is the work that remains to be done.

CHAIRMAN APOSTOLAKIS: Are you going to include the model uncertainty as well? Are not these equations --

MR. STROSNEYDER: I'm sorry, I didn't hear the question.

CHAIRMAN APOSTOLAKIS: The equation that gives you the operating time as a function of the crack growth rate, is that cast in stone or there is uncertainty about it?

MR. STROSNEYDER: That's two numbers moth planned together.

CHAIRMAN APOSTOLAKIS: That's all.

MEMBER KRESS: That's all it is.

MR. HISER: But in terms of the K that goes into determining what the crack growth rate is at each crack, that's a parameter. I mean --

CHAIRMAN APOSTOLAKIS: My second comment is that, you know, I realize there is a language that is being used in this community, but again we're going to try to make it consistent with the language we use in the risk-informed approach. This 95/50 business, I

just don't like it. I mean, we have terminology.

MEMBER KRESS: George, that's good terminology. I like the terminology because it's very descriptive.

CHAIRMAN APOSTOLAKIS: It covers the data? What is that?

MEMBER KRESS: Yes, but I think you have a real good point George.

CHAIRMAN APOSTOLAKIS: There is no probability theory that says that.

MEMBER KRESS: Oh sure.

CHAIRMAN APOSTOLAKIS: If you open up a epistemic distribution with the percentiles and that's the state of normal distribution, that's all you do.

MEMBER POWERS: Nonsense. This is well-developed analysis for experimental data.

MEMBER KRESS: Yes, absolutely. Everybody does that with experimental data.

CHAIRMAN APOSTOLAKIS: Everybody does use it.

MEMBER KRESS: Yes, but --

MEMBER POWERS: Greenfield, developing experimental data uses that terminology.

CHAIRMAN APOSTOLAKIS: That type of data goes into the distribution.

MEMBER POWERS: I know PRA has never recognized experimental data, but the rest of us actually work with that.

CHAIRMAN APOSTOLAKIS: We're talking about bigger people here.

MEMBER FORD: If I could suggest --

CHAIRMAN APOSTOLAKIS: Give me one probability that talks about this.

MEMBER KRESS: Oh, I can show you two or three of them.

MEMBER FORD: I think I've lost control of this.

CHAIRMAN APOSTOLAKIS: Back to you, Mr. Chairman.

MEMBER FORD: No, he's not ready yet.

MR. HISER: Can I just make one comment?

CHAIRMAN APOSTOLAKIS: Final comment, yes.

MR. HISER: The intent is to do probabilistic fractured mechanics assessments. What would go into that is this variety of crack growth rates.

CHAIRMAN APOSTOLAKIS: I understand that.

MR. HISER: Along with other parameters. So that would be considered under the PFM analysis.

MEMBER FORD: Okay. The objective of this

particular meeting was just to let the full, all the members know that we are advancing on this problem which is a generic problem in my view. We were planning on having a material subcommittee full-day meeting on this in February sometime. We may need to have it beforehand if we have any added value to the full process.

On that ground rules, I'd like to go around to the members and just ask if they've got any closing opinions, statements, on what they've heard so far.

MEMBER POWERS: I'm just tempted to say something abusive about Dr. Apostolakis' views about the distributions. I'll do that on the fly.

MEMBER FORD: Jack? George?

CHAIRMAN APOSTOLAKIS: I have a lot to say but I think it's too late.

MEMBER KRESS: One point. You know, we were debating about the source of which confidence level and which confidence on that we would use, and if you're going to use it in an overall probabilistic fractured mechanics, you ought to use them all to get a final distribution. But that doesn't solve your problem because then you're going to have to look at final distribution and say which part of it is of

interest to me?

I'd like to point out that Dr. Apostolakis has said many times that this is good place to use formal decision theory in order to decide where to use it.

MEMBER POWERS: He's just as wrong about that as he is about unprobability distributions too.

MEMBER KRESS: Yes, so I just wanted to make that comment.

MEMBER FORD: Steve?

MEMBER ROSEN: I'd like to make a comment on the pictures being worth a thousand words. The discussion that we had earlier seems to be extraordinarily tortured in trying to say that, for example, this picture is not in fact some evidence of leakage from a crack, and, I'm left very unconvinced of all that rationale.

MEMBER LEITCH: I'm a little confused by initial crack size versus crack growth. I don't have any idea -- I'm sorry. I said I'm a little confused by initial crack size versus crack growth. Do we have any idea that when these cracks occur, they go to some particular depth immediately.

And, what we're talking about here is the growth after that initial cracking? Until we know

what that initial depth might be, is there any thought or discussion on that, or -- in other words, do they grow at the rates we've been talking about here from zero, or what I'm saying, isn't there an initial crack and then what we're talking about is growth rate? That's what I don't quite understand. I don't know if there's any information in that regard.

MEMBER FORD: Quickly within the next ten seconds.

MR. HISER: There is uncertainty on exactly what is going on. Clearly the crack growth rate that we're using is fracture mechanics based. It has certain assumptions to it, and does not apply from zero, from the incipient crack. That is the kind of thinking that we need in a more phenomenological model to be able to extend this in a more scientific basis overall.

MEMBER FORD: Graham?

MEMBER WALLIS: All this is based on crack growth and PWR environments. I think you need to do more on crack growth in a crack environment with the real, some assessment or enough assessment of chemical flow or electromagnetic, all the things that are going on there, and I don't have a good factor for it.

But conceivably, you could have fluid

coming out of there at Mach 5 or something, whatever it is, you know, drifting away to it. I don't have a clue. But you haven't really said anything about what happens to flow dynamically, chemically and all of that and that is part of the problem.

MEMBER FORD: I'd like to finish off just by thanking all the presenters and apologizing for pushing you so much. We had only a little time. The main objective, as I said before, was just to let the full committee know that we are moving forward on this problem.

I think we have a material subcommittee potentially planned for February sometime, and if there's any value added, as I say, to our involvement before then, we're open.

George, I pass it back to you.

CHAIRMAN APOSTOLAKIS: Thank you, Peter. We will recess until five minutes after 11:00.

(Whereupon, the above-entitled matter went off the record.)

CHAIRMAN APOSTOLAKIS: Okay? The next item is licensing approach for the Pebble Bed Modular Reactor Design. Doctor Kress will guide us through this topic.

MEMBER KRESS: All right. There's two

parts to this. You say one of them talks about the future plant design workshop that Dana Powers and I have participated in on October 10th and 12th.

I don't intend to say anything about that because Dr. Powers once again has issued a remarkable trip report on this, and I recommend to read it to get the summary of that. I don't know if Dana wanted to say anything about that particular workshop more than his trip report or not?

MEMBER POWERS: No, I do note that Dr. Kress listed a set of 17 or 18 regulatory challenges that he distilled out of the meeting that also should be examined in conjunction with the trip report.

MEMBER KRESS: Yes, those didn't necessarily all come from that one workshop, but -- yes. Also, I remind the committee that during our October ACRS meeting, we had a presentation from Exelon giving us their proposed licensing approach for the next PBMR.

I won't have to remind you of what that approach is because I'm pretty sure the staff plans on reminding us of what it was. I thought it was a very interesting approach and, in fact, I thought it was a pretty good one. But today, we're hearing from the staff what their view of this approach is and perhaps

what issues, policy and otherwise that it might raise. Then I guess I'll turn it over to who over here?

MR. LYONS: I guess I'll start off.

MEMBER KRESS: Okay.

MR. LYONS: I'm Jim Lyons. I'm with NRR. I'm the Director of the New Reactor Licensing Project Office. Today, as Tom was saying, we want to come back and talk to you a little bit about the licensing approach that Exelon is proposing, and we've got a presentation to go through how we are seeing this. Actually, here's Tom. Do you have some opening remarks Tom that you want to make?

MR. KING: You may hear a status report on what we think of the Exelon proposal for fitting their design, the Pebble Bed into today's set of regulations. You're going to hear our thoughts on how we're looking at that, what criteria, thoughts we're using to try and make a judgment on whether that's okay or not okay, and again recognize that there's no final decisions.

There's probably some policy issues that are going to come out of this that ultimately the commission's going to decide. But at least it will make you aware of what they're proposing and what our thoughts are at this point on it.

CHAIRMAN APOSTOLAKIS: Okay.

MR. KADAMBI: Thank you. Good morning Mr. Chairman, and members of the advisory committee. My name is Prasad Kadambi. This is Eric Benner and this is a joint NRR research presentation.

We had an abbreviated presentation last month and we'll try not to repeat some of the things that were covered in some detail. This presentation is somewhat preliminary, only to the extent that we are looking for feedback from the committee, and we want to take into account whatever we can glean from the questions and comments, et cetera, so we can reflect it in the commission paper which is due this month.

We are looking for your questions, concerns about the proposed licensing approach, and our assessment of the licensing approach. We'd like to --

CHAIRMAN APOSTOLAKIS: Excuse me. We will review that document you will send to the commission?

MR. KADAMBI: Well, a predecisional draft, I believe, has been provided. I mean, we are looking for this feedback during the meeting and a letter if you feel it's necessary, but we are not necessarily requesting a letter.

The presentation that we will make broadly follows the format of the paper. The message that we got last month was that the ACRS wanted to hear more about the staff's overall approach, including any new ideas that we may bring to the table.

Our overall approach is to use the commission's directions, decisions, and policy statements to build a foundation for the PBMR Licensing Review. We found a lot of guidance in these documents and we feel that there is enough to proceed along the lines that we'll describe.

What we did not set out to do was, if I may so say, build a better mousetrap where, you know, we would start from a clean sheet of paper and try to invent a regulatory system or framework. We believe that a separate effort is underway. We don't know very much about it, but we believe that NEI is going to be undertaking something like that.

As we said, the licensing of Fort St. Vrain more or less began our venture into using the current regulations into licensing something that is not a lightwater reactor. Eric, do you want to talk about that?

MR. BENNER: Yes, and again to emphasize what Prasad was saying, and I believe you heard some

of this yesterday, that there are activities going on both with the DOE NERI Project and NEI and looking at building on 3, to look at a more clean sheet of paper approach.

There's a commission paper due on that middle of next year to look at various options, and I believe one of the options that's going to be considered is, you know, how would you apply the current regulations with some other sources of information to see how they fit, along with the clean sheet of paper to see the relative merits of the different approaches.

Basically, the group that was accessing Exelon's approach looked at the licensing of Fort St. Vrain more to assure itself that there is a way that you could use the current regulatory structure to license a non-lightwater reactor, and the meat of that was really the applicability of the GDC, which for the most part are pretty general. And, at that time, the staff also focused on some of these higher level topics of defense-in-depth and multiple concentric barriers to contain radiation.

This was sort of the stepping stone for the staff's look at Exelon licensing approach just to see whether there was merit to moving forward with

using the existing regulations as a licensing approach.

The next thing the staff looked at was the pre-application review for the MHTGR. The meeting that took place in the mid-'80's, the MHTGR was a gas-cooled reactor. At that time, it had a steam cycle and recently General Atomics has somewhat modified this design to make it direct cycle, and we're going to be talking about the application review of that sometime in the future with the ACRS.

But for this review, there was extensive staff work and DOE work on a licensing approach that was very similar to what Exelon is proposing, and at that time, the staff looked at conformance of the approach with the advance reactor policy statement as well as, just like in the case of the Fort St. Vrain, the NRC regulations, reg. guides and standard review plan that they found to be applicable.

Staff provided assessments in a new reg in 1989. After that time, there were the design certification reviews going on for AP600, ABWR, and System 80 Plus, and during those design certifications, whenever the staff distilled an issue that they thought would be applicable to the MHTGR, they kind of put it off to the side and tried to

address it in the communications that were going back and forth between the commission and the staff.

The staff basically wrapped all those up in a paper to the commission containing a draft new reg in 1985 and kind of discussed where they were applicable and how they were applicable to the MHTGR, and essentially the gas-cooled reactor technology.

So, we have used a lot of the findings that the staff provided at that time also as a basis for our review.

MR. KADAMBI: What we have tried to do in trying to identify the main considerations that would be the basis for the staff's review is to more specifically sort of identify the particular commission directives and decisions and the policy statements in the context of the agency's strategic plan and performance goals.

So what I'll try to do over here is try and describe the individual components that we feel are relevant in doing this. The advance reactor policy statement in a sense provides a guidepost, although it's not a qualitative one, it does say that as a minimum, an advanced reactor should provide the same degree of protection as the current fleet of operating reactors.

CHAIRMAN APOSTOLAKIS: How do you mention that?

MR. KADAMBI: Well, in a sense that's a separate question which, you know, at this point I'm trying to in a sense define the problem areas.

CHAIRMAN APOSTOLAKIS: As a guidance?

MR. KADAMBI: Yes.

CHAIRMAN APOSTOLAKIS: Okay.

MR. KADAMBI: So, trying to just lay out the framework, if I can use that word, the policy statement also says that the commission expects that using simplified inherent passive or other innovative means that enhanced safety margins would be realized.

MEMBER WALLIS: How can you have the same degree of protection and enhance safety margins at the same time? No, it's at least the same.

MR. KADAMBI: Yes.

MEMBER WALLIS: Oh, at least. Okay.

MR. KADAMBI: And I believe that one way of looking at it, at least this is the way I look at it and some of these things are my own thoughts right now is that you ought to have more confidence that you're achieving a given level of safety on some distribution when you're using these simplified methods, et cetera.

MEMBER WALLIS: Oh, you should go with the

95/95 one.

MR. BENNER: During the design certifications that we did go through, some of that expectation was realized through some of the severe accident management expectations. So that may be another way where we talk about enhanced margins for this particular advanced design.

MR. KADAMBI: In fact, the decisions that were taken on AP600, System 80 Plus, et cetera, do show us how the advanced reactor policy statement and the current set of regulations are brought together in order to accomplish what the commission wanted.

In all, this is what we perceive as essential to the role of defense-in-depth philosophy. This can not be stressed enough.

MEMBER WALLIS: Sounds like a religious statement, invoking.

MR. KADAMBI: In many ways --

MEMBER WALLIS: It is.

MR. KADAMBI: -- it has become that.

CHAIRMAN APOSTOLAKIS: Is what? I didn't get it.

MEMBER WALLIS: Religious statement, invoking virtue by appealing to the sainthood so the sanctity of the defense-in-depth.

MEMBER POWERS: Yes, but it's --

MEMBER WALLIS: Sure, some of us.

CHAIRMAN APOSTOLAKIS: Raise the slide please.

MR. KADAMBI: It's such a vague thing.

CHAIRMAN APOSTOLAKIS: Put it higher, the slide itself.

MEMBER WALLIS: Like saluting the flag or something.

MEMBER POWERS: Well, I don't know that I would agree with you that the depth is vague.

MR. KADAMBI: At least if I may, I'd like to go to what we have found from the commission's, again various documents that we have seen to identify the individual attributes that feed into defense-in-depth, and to some extent this is where, you know -- we begin with the basic objective of finding a defensible basis for making an adequate protection finding, and because defense-in-depth is so key to that, there are several sources where we can find guidance on what we look for on defense-in-depth.

The white paper called Risk Informed and Performance Based Regulation, which was issued in March of 1999, you know, it was issued to the public and to the staff with the commission direction that it

should be used. You know, it says that defense-in-depth is the employment of successive compensatory measures of prevention and mitigation.

It is something that does not wholly depend on any single element of design construction, maintenance or operation. It's something that if it is done right would be more tolerant of failures and external challenges.

MEMBER WALLIS: All of which needs to be quantified in some way.

MR. KADAMBI: Certainly as we get into the details of a given design, you know, these are the sorts of things that we would seek to quantify.

Further in specific applications, relative to the risk informing effort of Part 50, Option 3, the staff further identified elements of defense-in-depth that are dependent on risk insight and those that are independent of risk insight.

Examples of those that are dependent on risk insight are limiting initiating events, cold damage frequency releases, et cetera, and achieving the kind of safety function probabilities that would be consistent with what needs to be achieved.

The elements that are independent of risk insight are things like balance between prevention,

containment, consequences, the avoidance of reliance on programmatic activities and, you know, adhering to the principles of the general design criteria.

So, you know, these sorts of things that we have done in the recent past give us, we believe, a sufficient high level of guidance on how we can deal with the concept of maintaining safety.

The next performance goal I'd like to address is increasing public confidence. Again, I see some significance to the vector that's associated with the performance goal, that this is something that we want to increase, and I believe that increase would be relative to where we are on the current generation of reactors.

MEMBER POWERS: Before you go on to public confidence, could I come back to maintain safety?

MR. KADAMBI: Sure.

MEMBER POWERS: It seems to me that there is an element missing here and it's born of the fact that when you look for guidance from the regulations that have transpired over the last 25-30 years, you're looking at a fairly well established technology as far as the material.

And yet, just minutes ago we heard a presentation on where this relatively established

materials and technology is surprising those that have tended and cared for it, because things break that they didn't anticipate breaking.

Now, with some of these new concepts, either the gas-cooled reactor, you're wandering into an area of materials that you have relatively little experience with, relative to the kind of support infrastructure that you have with metals and things like that. And I'm wondering if there isn't room in this for some appeal to a generally conservative design philosophy in your list of things that you're looking at?

MR. KADAMBI: I think --

MR. BENNER: One of the things we have been doing, and I can't speak for the staff in research, but I'm sure they're doing this, the material staff and NRR has been working with ASME to start talking about what some of the materials challenges are going to be for the licensing of future designs. And as far as whether there will be, you know, that we'll try to employ general conservatism overall or just in those specific areas where we don't feel comfortable with materials, I don't think we've gone that deep into the infrastructure.

MEMBER POWERS: I think you need to

recognize no matter how much talking with ASME you do, even they will not have the kind of database and experiential base that you have with the metals that you're using in the current fleet of reactors.

MR. BENNER: That's been a struggle is trying to get materials data and Raj Pathania of research has been working to get access to a graphite, a radiated graphite materials database from IAEA as one source, and obviously the staff's going to have to look at the available data and determine.

MR. KING: I think it's important to recognize that Fort St. Vrain was not the only graphite reactor run in this country, that there was a very large one up in the northwestern part of the United States, and that they have quite a lot of data. Unfortunately you can't get their kind of graphite, so.

MEMBER POWERS: But I think what your point is how do you compensate for the lack of data, whether it's materials, graphite or anything else? In principal, the way you do that is you develop a monitoring program that maybe is more extensive than you would if you had such data. I think it's part of the research and part of looking at what we ought to do in licensing these plants.

I think monitoring is one aspect to it. I think holding people to a more conservative design standard is another one. There's probably a trade-off there someplace, but it's not a complete substitution. A lot of what we're doing in the regulatory body nowadays could be interpreted as a liberalization born of the fact, you know, we have 3,000 reactor years of operating experience with the current fleet and we shouldn't leap to the belief that that liberalization is applicable to some new design.

MR. KADAMBI: I think we agree.

MEMBER POWERS: I encourage you to articulate that.

MR. KADAMBI: I hope we will as we go through this. I think it's really part of what underlies everything we have to say about how we will proceed with the review.

Anyway, on the matter of increasing public confidence, again we believe the advance reactor policy statement did state that we should provide stakeholders a timely and independent assessment and that's one of the reasons we are trying to abide by an aggressive schedule to bring out, you know, what the current thoughts that the staff have are on this matter. And also, we are of course being very careful

to provide opportunity for feedback and comment on the part of all stakeholders at every opportunity.

Now in terms of increasing efficiency, effectiveness and realism, we find many of the elements that have been described in Reg. Guide 1.174, again the white paper, and the Option 3 Framework to be useful in proceeding. Reg. Guide 1.174 does talk about using appropriately the exemption process.

Again, being consistent with defense-in-depth philosophy, assessing safety margins very carefully, paying attention to performance monitoring, the safety goal policy, all these things come together in terms of how the particular issues that were dealt with in Reg. Guide 1.174 were dealt with, even though that was really in the context of making changes to the licensing basis.

In the white paper, there is reference to performance based approaches and the staff has issued high level guidelines for performance based activities which in some matter may appropriately be applicable in increasing efficiency effectiveness and realism.

The Option 3 Framework also stressed defense-in-depth philosophy, and consideration of core damage accidents. By the way some of these things, you know, we just don't really know what the

equivalent would be in a Pebble Bed reactor, but at least conceptually these are the things we would be looking for, and of course, the stress on all the different types of uncertainties that one should pay attention to.

On the fourth performance goal of reducing unnecessary regulatory burden, what we find is that the commission has over the years stressed the rule of the safety goal policy statement as defining -- I mean, at least providing a basis for saying how safe is safe enough? You know, of course this raises policy issues some of which we will talk about later, but in addition to this performance based approach, where appropriate could mitigate some regulatory burden by providing licensee flexibility, provided the margins are maintained.

Now this picture you saw last month and we wanted to make it available here just to provide a basis for how we are viewing this effort of screening of the regulations. What we'd like to stress is, we will independently, you know, undertake the kind of screening required, but the process itself, the logic flow seems to be adequate to proceed.

CHAIRMAN APOSTOLAKIS: Now, let me understand this a little better. I see under the

diamond that says "compare completely applicable, partially not applicable, PBMR specific." So, where is it that we're adding things, adding regulations to replace the ones that aren't applicable, under PBMR specific?

MR. KADAMBI: Correct, although they may not be regulations. They may be regulatory requirements through license conditions.

MR. BENNER: I think there are two things that go in that box, and there are some places where a regulation may not be applicable just on its face because of the language, but there's an underlying concern that drove the staff to move towards a regulation.

CHAIRMAN APOSTOLAKIS: Which was my next point. If you go up to the left, it says "function level or intent of regulations." So when it says "partially applicable" is it referring to the regulation itself or its intent?

MR. BENNER: The Exelon approach talks about partially applicable, as when you have a regulation that has three parts and two parts are applicable and one is not; whereas, there are like we just talked about, applications that on their legal face may not apply, but there's an intent there, and

how that gets handled as applicable or have to come up with a PBMR specific license condition, we're still working with OGC on that.

MEMBER WALLIS: I'm a little bit puzzled by the logic flow here. I don't see how you can design a PBMR if you don't know what the rules are. You sort of assume the thing is designed and then someone figures out how to regulate it?

MR. KADAMBI: Well, I mean the design, I believe a case that's been presented to us so far, which is at a relatively high level, it doesn't have a lot of details in it, but it's based on certain physical principles that will --

MEMBER WALLIS: So what can you change, how it's operated or what?

MR. KADAMBI: I mean certainly at some point, you know, if we don't have sufficient assurance of some physical capability beyond the operational aspect may have to be changed. But right now, we see the PBMR specific box being populated entirely by, or substantially by, you know, the right side of this diagram. And so, you know, it's not that we don't know anything about the PBMR, but we certainly don't know enough to see --

MEMBER WALLIS: So a cynic might claim that

you're going to be confronted with an existing design and you're going to be told "find a way to license it."

MR. BRENNER: Well, part of the pre-application review and part of the discussions we're having with Exelon is to, as we get some design assumptions, to determine what regulations are applicable so that they can make changes to the design now as opposed to when they come in during the licensing phase.

MR. KING: That's the main purpose of the pre-application phase to dig out these things up front before they've gone through and spent a lot of money to develop a final design.

CHAIRMAN APOSTOLAKIS: Part of the problem with this approach though, which you have not said you have accepted or whatever. I realize you're presenting what Exelon has presented. It's something I think Tom King also referred to yesterday. If you just do it this way you may, you know, be gaining perhaps efficiency in the short term, but in the long term maybe not because now what do you do? Next time you have an IRIS, then you do the same thing and now you have IRIS specific, then something else.

Wouldn't it be better to try to think a

little more broadly and see what kinds of fundamental principles and requirements we want to have for all technologies, and then have the box that says this is technology specific, not technology specific.

MR. BENNER: I think that's the goal of where eventually we're trying to get to, because some of the people on the working group looking at this approach are also supporting and looking at Option 3 and advance reactor regulatory framework so that hopefully in going through this, we're trying to keep our eyes open for where, you know, because of something that the staff and the applicant wrestled with, does a principle come out of that that needs to go up to the highest level. And also, have we identified a gas cooled reactor specific requirement that needs to go on the lower level, whatever it ends up being, whether it be a regulation or a guidance document.

VICE CHAIRMAN BONACA: It has to be high enough and flexible enough that it doesn't prevent innovation in designs. What I mean is I totally agree.

MEMBER KRESS: Well, they have two problems. One of them, Exelon has come in with this as a proposed approach and they want to know what the

staff thinks about it, so they have to focus on that. But how many times they've done, they can be thinking about how to have general principles that focus their attention on what they think about it.

VICE CHAIRMAN BONACA: Sure.

MEMBER KRESS: I think they're working both sides of it.

MR. KING: And the two compliment each other, because the PBMR illustrates a number of issues that we're going to have to deal with on future plants, containment issue, the emergency planning issue, a number of these key issues. So, it's useful to have the two going on in parallel because they do cross fertilize each other.

MR. BENNER: We can go on. I think we've really covered most of what was on the slide in the discussion of the graphic. So, basically it's screen the regulations, find out the applicable ones, apply them, and final determinations will be made by the regulator.

MR. KADAMBI: You have seen this before also, and we just present it to refresh your memory on it.

VICE CHAIRMAN BONACA: Yes. One question I have on this. This clearly is not -- we discussed

it. It was not a frequency consequence curve in the sense of integrating all of the results. It is actually a very useful curve to determine initiators and frequency that should be associated with them. Would you plan to have also a frequency consequence curve that provides the outcome? I mean, when you integrate all of this?

MR. BENNER: In one of the rounds of questions we had with Exelon we saw, as one of the things they need to do, was to somehow sum up the consequences of all the events, or at least show that the events they've identified represent the majority of the risk, and somehow compare that to the safety goals.

CHAIRMAN APOSTOLAKIS: So how is this curve going to be used? Can you explain to me -- I mean --

MR. BENNER: We see this, really, as a plot of the -- some of the high-level regulations that are applicable to the PBMR. So it's useful to illustrate what some of the bounds are.

MEMBER WALLIS: This is a continuous curve and events are all discrete.

MR. BENNER: Discrete.

CHAIRMAN APOSTOLAKIS: But if I enter,

say, at .1 rem, right, on the horizontal axis, and I go up and I hit the mean frequency of 2.5 10^{-2} per reactor year, what does that say in terms of the design? How am I going to use this? That's what I don't understand.

MR. BENNER: I think the way the staff sees this as being used as just -- we are going to apply the regulations that they reference as they are intended to be applied. This just provides a graphical representation. Basically, we identify, you know, events that need to be designed for in the design basis region, and they meet -- need to meet 10 CFR 50.34.

So there -- you know, that's why we don't really consider this a frequency consequence curve, because that regulation was designed to apply to discrete events.

VICE CHAIRMAN BONACA: I mean, they were very clear that this was the equivalent of what was used in the FSARs when you set the categories, you know, anticipated transients and LOCA, and so on. I mean --

CHAIRMAN APOSTOLAKIS: But that doesn't make it right.

VICE CHAIRMAN BONACA: No.

CHAIRMAN APOSTOLAKIS: Because, again, you know, I have a lot of flexibility in defining the events. That's the problem. If you say -- you make it workable if you say all the events that may lead to .1 rem or greater must have a frequency smaller than the bound, then it makes sense. So --

MEMBER ROSEN: All the events individually or summed?

CHAIRMAN APOSTOLAKIS: All together.

MEMBER ROSEN: All of them, if you sum them up --

CHAIRMAN APOSTOLAKIS: If you sum them up, their frequency should be less than 2.5 10^{-2}.

MEMBER ROSEN: Well, that's what this curve says.

CHAIRMAN APOSTOLAKIS: No, no.

VICE CHAIRMAN BONACA: We're talking about individual it will be the frequency. This is individual. This is like saying, for example --

CHAIRMAN APOSTOLAKIS: Pick one.

VICE CHAIRMAN BONACA: -- assume you apply this to the current set of reactors. You would say that a LOCA, which has a frequency of 10^{-4} cannot have, you know, a dose higher than -- and you go to the right and you find the dose limit for the LOCA.

Okay? All LOCAs individually have a dose higher than that.

MEMBER ROSEN: So if Exelon says it's -- you take it event by event, and George has just postulated that different one, which is to sum all of the events, it should be --

VICE CHAIRMAN BONACA: That's why I asked the question -- the first question about a frequency consequence curve that would, in fact, integrate.

CHAIRMAN APOSTOLAKIS: That's right. But that was the original intent of the Farmer curve. It was confused and the interpretation was not clear for a number of years.

MR. BENNER: We're looking at that two ways. One is --

CHAIRMAN APOSTOLAKIS: By the way, it will not be -- it doesn't have to be the same curve you are showing there if you interpret it correctly. You may have --

MR. BENNER: And that's one of the things we brought up with Exelon about the safety goals dealing with the integral. The other thing we're talking about is maybe integrating somehow the area under this curve to see where that compares to the safety goals, so that while these will be a

representation of the current regulations, it will also give us some guidance as to, you know, maybe for the future for developing a frequency response curve.

VICE CHAIRMAN BONACA: I want to say actually that the existence of this curve -- it's confusing.

MEMBER WALLIS: Do you rely on Exelon to determine what the events are, or are you guys going to tell them what the events are they must consider?

MR. KADAMBI: Well, we will take full liberty to, you know, make sure that the events we think are important are considered, along with whatever that Exelon proposes.

MEMBER WALLIS: Are you going to imagine all of the scenarios and then tell them they ought to consider these?

MR. KADAMBI: In some ways, that's part of what goes into it is to imagine the scenarios and to -- to make sure that --

CHAIRMAN APOSTOLAKIS: Which means to do a PRA, right?

MR. KADAMBI: Well, yes. Eventually, that's what it will all lead to.

MEMBER KRESS: Basically, I think in your Chapter 15 for LWRs, you have a set of design basis

events. And these are things like you have holes and you lose coolant or you inject a rod or you have an ATWS event or loss of power, and various sets of events that have been chosen for -- to look at as design basis events.

Now, I viewed this as an attempt to decide what those events would be for the Pebble Bed Modular Reactor. And you would start out by using similar type of things, I think. Overall grand events like a -- like --

CHAIRMAN APOSTOLAKIS: Let's not forget, though, that even for the design basis events, after we did the PRAs, we did extra things to mitigate, I think, consequences, didn't we? The Level 2 stuff?

MEMBER KRESS: Well, you had --

CHAIRMAN APOSTOLAKIS: I mean, you can do the same thing here.

MEMBER KRESS: You had principles like a single failure principle, and then you had to meet certain figures of merit. And then, you know, there's questions about what --

CHAIRMAN APOSTOLAKIS: The station blackout was not a design basis event, was it?

MR. KING: No. That came because of PRA insights.

CHAIRMAN APOSTOLAKIS: PRA, that's what I'm saying.

MEMBER KRESS: Yes. But now that we know that it was an important thing, we might look at it for this.

CHAIRMAN APOSTOLAKIS: No. The point is that, again, curves like this -- I mean, we have a lot of discussion in Regulatory Guide 1.174 about it should not be taken as absolutes with bright lines, and so on.

MEMBER KRESS: Right.

CHAIRMAN APOSTOLAKIS: And all of that stuff. But I think that the question, how do you determine the so-called design basis events, or whether you actually need that, is a good one. It's an important one. One way of doing it is what Dr. Kress just suggested. But there may be other ways, too, or a combination of ways.

VICE CHAIRMAN BONACA: One thing I want to note is that to some degree that curve that we liked last time at the meeting creates confusion, because what I --

CHAIRMAN APOSTOLAKIS: No, I didn't like it.

VICE CHAIRMAN BONACA: No. Because we all

understood -- I understood there was, at the beginning, a frequency consequence curve and then we discovered it wasn't.

CHAIRMAN APOSTOLAKIS: It was not.

VICE CHAIRMAN BONACA: Typically, the expectation for it is to be that, and the fact that this is already on paper leads one to believe that it has been developed and it hasn't been developed. So --

MEMBER KRESS: But I think if you use that kind of curve to select design basis events in a particular way, and then you go to frequency consequence curves as your figure of merit --

VICE CHAIRMAN BONACA: No, I understand.

MEMBER KRESS: -- to see if -- see if these things are -- the design part of these events are acceptable.

VICE CHAIRMAN BONACA: I completely agree with you. I'm only saying that the fact that it was presented almost made everybody feel, oh, we got it. And, well, we haven't got it.

MEMBER ROSEN: Well, I see the value of this is that it avoids the arguments about when someone postulates a new event, someone typically reacts, "Well, that's well beyond the design basis.

We're not going to think about that."

MEMBER KRESS: Yes.

MEMBER ROSEN: And that -- this gets away from that completely.

MEMBER KRESS: This -- yes, that gives you a way to --

CHAIRMAN APOSTOLAKIS: But it has to be right. It has to be -- the concept of having the curve does that.

MR. BENNER: And I think that's a good lead-in to our concern about licensing basis events, that we do --

CHAIRMAN APOSTOLAKIS: By the way, have you seen what the Dutch have done along these lines? They had passed a regulation I think in the late '80s where they actually used frequency consequence curves in regulating nuclear and chemical plants. And then a few years later somehow they got out of it or part of it for some practical reasons that came from experience. So that probably would be another source of information for you.

MR. KADAMBI: We'll make note of that.

MEMBER WALLIS: To get back to Dana's point about conservative design, in trying to license water reactors there was a lot of experimental

evidence in terms of LOF tests, and so on, and scale tests of this, that, and the next thing, because we didn't rely just on calculating things.

And the impression I get is that this is supposedly a more calculable system, so you don't need to do a whole lot of these tests?

MR. BENNER: No, I think in -- in some of the documentation back to Exelon that we're struggling right now with what level of testing is going to be necessary to validate any assumptions they may be making.

MEMBER WALLIS: So is there data on combustion of piles of graphite balls in various configurations, and so on? All of that stuff is there?

(Laughter.)

MR. KING: That's part of the -- part of what we're trying to do now is gather what information is out there that supports graphite behavior, fuel behavior, high temperature materials behavior, and then some judgment is going to have to be made on what the licensee or applicant has to do to expand that to apply to his design and what we, NRC, want to do to have some confirmation of what the licensee is telling us, or to push the margins and see where the cliffs

are.

That's the thing we talked about yesterday when I said for the HTGR we're developing a research plan over the next several months, and we're going to come to the committee hopefully in February and talk about that.

MEMBER WALLIS: But if it's something like the LOF tests, then this thing is dead in the water because there's not that much money around from the agency and the licensees to do those LOF-like tests.

MR. KING: Yes. But maybe you don't need a LOF-like test for a helium reactor. You know, maybe you need some smaller scale phenomenology-type test, fuel performance, graphite performance. But those questions are still on the table and are going to have to be worked out.

Part of the pre-application review is to try and settle those things up front. So the licensee or the applicant knows if we're expecting a large-scale test on some phenomena, that he knows that now. He doesn't know that, you know, two years after he submits an application.

MEMBER LEITCH: This mean frequency curve has units of per plant year. Do you know if that -- by that nomenclature is it meant a module?

MR. BENNER: No, it's up to 10 modules.

MEMBER LEITCH: Up to 10 modules.

MR. BENNER: That's how they're planning on --

CHAIRMAN APOSTOLAKIS: So you are automatically, then, doing what I suggested at the workshop that Exelon didn't seem to like. You are reducing the goals per unit. Are they aware of that?

MR. KING: It's their proposal. They came in and said that's the way they're designing.

CHAIRMAN APOSTOLAKIS: Did they make it clear this is the plant or the unit, the module?

MR. KING: No. Exelon said, "We are considering a plant is up to 10 modules." And, therefore, for an individual module --

CHAIRMAN APOSTOLAKIS: Ah, for an individual module the curve --

MEMBER KRESS: -- risk goals will be, you know, a factor of 10 less.

CHAIRMAN APOSTOLAKIS: But that's not what Eric just told us. This is for 10 --

MR. BENNER: I thought they flipped it around, that these would be applicable to --

CHAIRMAN APOSTOLAKIS: Ten modules.

MR. BENNER: -- 10 modules.

MR. KING: Yes, for common -- where there's common cause failures, you know, that they would expect all 10 modules to meet that. Right.

CHAIRMAN APOSTOLAKIS: As a group.

MR. KING: As a group.

CHAIRMAN APOSTOLAKIS: So, in essence, for -- on a per module basis, we're going down, the goals go down. Right?

MR. KING: Yes. Certainly things like CDF, if we can define a CDF for this, it would go down.

MEMBER ROSEN: It would seem to me irrational to do anything else. I mean, you have 10 nuclear reactors there.

CHAIRMAN APOSTOLAKIS: That's right.

MR. KING: Yes.

CHAIRMAN APOSTOLAKIS: The problem is still -- they can come back and say, "Look, we may not build all 10 of them," so there may be a period of many years where there will now be two. But, again, you know --

MEMBER ROSEN: So you have two critical reactors on the site. But you have to -- you can't say that we really -- if you have seven, that you really only have one. That's irrational.

MEMBER POWERS: Yes. But I guess that raises the question, suppose I have one, but I may or may not have 10 in the future. Does that mean while I have one I can run that sloppy, and I only have to clean my act up when I start adding other modules?

(Laughter.)

MEMBER KRESS: That's a rationalist position.

(Laughter.)

MEMBER WALLIS: The tenth one has to be absolutely perfect. Pristine.

MR. BENNER: I actually think we've covered most of this slide.

CHAIRMAN APOSTOLAKIS: Yes.

MR. BENNER: To the concern about being able to raise up additional --

CHAIRMAN APOSTOLAKIS: Is licensing basis events a new terminology?

MEMBER KRESS: It's like design basis.

CHAIRMAN APOSTOLAKIS: I know. But it's new.

MR. BENNER: And it's supposed to cover the spectrum, both above and below design basis.

CHAIRMAN APOSTOLAKIS: Well, I mean, it's everything.

MEMBER KRESS: That's right.

CHAIRMAN APOSTOLAKIS: You have already assumed, then, that we need licensing basis events? I mean, there would be other ways.

MR. BENNER: Well, I think some of that gets into -- for licensing of the first PBMR using the current regulations as -- as the scheme. That seems to be an inherent part of how the regulations work.

CHAIRMAN APOSTOLAKIS: In any case, the licensing basis is broader, so you have a home there to add that in.

MEMBER KRESS: If you had an FC acceptance curves you could use the whole spectrum of sequences as your --

CHAIRMAN APOSTOLAKIS: On the other hand, there is a lot of value to the --

MEMBER KRESS: Oh, yes.

CHAIRMAN APOSTOLAKIS: You make it --

MEMBER KRESS: It really helps --

CHAIRMAN APOSTOLAKIS: It helps everybody focus.

MEMBER KRESS: -- focuses a lot of --

CHAIRMAN APOSTOLAKIS: Okay.

MR. BENNER: I think -- there is where we talk a little bit more about what would the licensing

basis for the PBMR be, and we see it as the set of requirements that apply to all of your safety-related structure systems and components.

One of the concerns we see in trying to assess the acceptability of the design is it relies a lot on inherently reliable passive components. And you get into the concerns of what special treatments do you need to make sure that, you know, those inherently reliable components retain the quality that you're assuming of them.

Another aspect that came up in the design certification reviews was the concept that, you know, you would have a lot of these passive systems, which would be what you would rely on to mitigate an event, but you would also have active systems which would provide a defense-in-depth function. And the Commission provided some guidance on how the staff should treat those -- those components.

One of the things that Exelon proposes, which the staff is struggling with, is component-level special treatment. And in the development of the special treatment work done on South Texas Project, the staff found that that was virtually impossible. That you could look at functions, you could look at system requirements, but to try and bring that down to

the individual component level was very difficult.

Now, we're not precluding that. It may be able to be done for the PBMR. We're just raising that as a potential challenge.

VICE CHAIRMAN BONACA: Although I think the considerations that Dr. Powers mentioned before very much apply here, that, you know, for a lot of these materials maybe you have to be more than conservative.

MEMBER ROSEN: Well, I think in the case of South Texas, the argument was that we had a lot of performance-based information about equipment. And as Dr. Powers said, we have a lot of new equipment here, and with no history or very little history. So the conditions are different.

CHAIRMAN APOSTOLAKIS: What is the third bullet, defense-in-depth also provided for non-safety-related SSCs? What does that mean?

MR. BENNER: That was a concept that was really brought up in the review of the AP600, where to call it a passive design, they wanted to identify only the passive systems as safety-related.

CHAIRMAN APOSTOLAKIS: So that was the regulatory requirements for non-safety-related --

MR. BENNER: Exactly. That's exactly it.

CHAIRMAN APOSTOLAKIS: And we are keeping the terminology of safety-related versus non-safety-related?

MR. BENNER: I think at this point, yes.

MEMBER ROSEN: Why?

CHAIRMAN APOSTOLAKIS: But that's a problem now. We are keeping everything from the existing regulations that in another arena we're trying to get rid of. I realize the problem you are having, but at least say that it's something you're going to think about. I realize that, you know, you really have to start somewhere and proceed.

MR. KADAMBI: And also, this is part of what Exelon has proposed. You know, they have kept the terminology, and they are defining it in a certain way, and we are looking at it in the context of, you know, can it be applied in the context that they are --

CHAIRMAN APOSTOLAKIS: Well, is there a methodology in the existing regulations for defining what is safety-related?

MEMBER KRESS: Sure. It's what's needed to meet the figures of merit for the design basis --

MEMBER POWERS: But, I mean, this does strike me as one of the areas I -- this is going to

pain me to admit -- where -- that's the strength of the probabilistic-type analysis methods, were you can look at the plant in some sort of an integrated fashion and escape the problems that arise when you look at it in train-by-train fashions that it was done in the past. It was done by necessity in the past.

It seems to me that this is one area that the -- where the rationalists and the structuralists really agree on this is this -- in the categorization of equipment is where the PRA really has a strength.

MEMBER KRESS: And like they say, there's a problem doing that down at the component level.

MEMBER POWERS: Because it'll show up in the PRA.

CHAIRMAN APOSTOLAKIS: I must say, though, that I'm very happy that Dr. Powers has not entirely lost his ability to reason rationally.

(Laughter.)

MEMBER ROSEN: He is a structuralist with some rational tendencies.

CHAIRMAN APOSTOLAKIS: Flashes of rationalism.

MEMBER ROSEN: Flashes, yes.

(Laughter.)

Whereas I am a rationalist with some

structuralist tendencies.

MR. KADAMBI: We have tried to identify some potential policy issues. At this stage, it's a little premature to present this to the Commission as policy issues. We're still working on them. We have to keep in mind that this is the review that we did of a submittal that we got in August -- on August 31st, and we are still, you know, developing information.

But the sorts of things that will certainly lead to policy issues are the use of probabilistic criteria, where maybe they have not been used before.

MEMBER KRESS: Haven't we always done that, though?

CHAIRMAN APOSTOLAKIS: For seismic, I think we have. We've always --

MEMBER KRESS: I thought we've always done that, even with the fully structuralist deterministic process.

MR. KING: Well, we've done it qualitatively. I mean, everybody has sort of had, you know, something qualitative --

CHAIRMAN APOSTOLAKIS: But that -- with one PRA, I mean --

MR. KING: But, remember, what's being

proposed are some quantitative frequency guidelines that you would decide what's in and what's out for the design, and that's going beyond what we've done in the past.

Now, maybe we've done it probably in a couple limited situations. We've put some numbers in a Reg. Guide or a standard review plan. But this is across the board, everything.

MEMBER POWERS: But we always defined accidents and scenarios based on whether they were credible or not. And some people I think define credulity with a number, but the fact is we've always used risk as a --

VICE CHAIRMAN BONACA: But one thing I wanted to say is that it is also true that there are, for example, events -- and I think it's important for the presentation we had this morning, like rodejection accident. At some point, it was a true proposal on the floor for years to eliminate it because it cannot happen.

Well, I mean, we are not looking now at cracks in CRDM nozzles, and suddenly, you know, this exercise in reactivity insertion becomes more credible. So I think -- I think it's a dilemma they're facing. Sure, I mean, because at some point

in time you might find something like this so unlikely that you just don't consider it.

CHAIRMAN APOSTOLAKIS: But the thing is -- I think Tom is right. I mean, if you say go with option 3, which gives you high-level frequencies for core damage for LWRs and protection, and so on, then what do you do with that? I mean, you have to keep going down to the design, right, and have some quantitative criteria or goals or guidance -- not criteria -- guidance for function level on availabilities, and so on. And I think that's fine. I mean, it is something that the Commission should explicitly comment on and decide on.

MR. KING: But see, option 3 is looking at an existing set of regulations and hopefully approving them. This is taking a clean sheet of paper and a design and saying, "I'm going to use probabilistic numbers to decide what we'll design for and what we don't design for." That goes beyond where we've used probabilistic information in the past.

CHAIRMAN APOSTOLAKIS: Yes. But option 3, even for LWRs, I mean, it just says the core damage frequency should be this. But, I mean, if you wanted to design in your reactor -- a new LWR with that, you will need some guidance how far down to go with these

numbers.

MR. KING: And you could take the option 3 guidelines and design a reactor to those. The policy question I see for the Commission is, do we want to go that far in applying probabilistic -- quantitative probabilistic guidelines?

CHAIRMAN APOSTOLAKIS: Yes.

MR. KING: And what other factors do we want to bring into this decision?

CHAIRMAN APOSTOLAKIS: I think it's going to be a combination. There's no question about it. It's not going to be just the numbers.

MEMBER ROSEN: I heard an answer from someplace over in the rational corner here. But I want to -- the question I have is about the process. Are we going to weigh in as ACRS on these questions?

MEMBER KRESS: Oh, probably eventually, maybe not right now. We're already weighing in a little bit. But as I see it, Tom, the -- we -- these policy issues come head to head with our -- what our definition, and I consider it a limited definition, of defense-in-depth.

That's where there is a collision here, and the question is, if you just use pure probabilistic criteria, you have to decide on where

defense-in-depth fits into that choice to making these decisions. I think that's the issue, and I think it's going to require a little bit different thinking than on what defense-in-depth is, more than what's in 1.174 and more than what's in option 3.

MR. KING: Yes, I agree with you. And at this point, we're not asking for the Committee to weigh in on these policy matters, because we haven't reached a position yet on it. Just for information, you know, that these are coming down the road at some point.

CHAIRMAN APOSTOLAKIS: I think the first bullet, though, might scare people.

MEMBER WALLIS: I don't understand the first bullet. Do you mean --

CHAIRMAN APOSTOLAKIS: Why don't you say use the risk-informed approach to selecting licensing basis events.

MEMBER WALLIS: But you first have to analyze a whole lot of events. Then you --

CHAIRMAN APOSTOLAKIS: Well, the implementation is somebody else's problem. But here they talk about criteria, which I think is going to scare everybody. It would be a risk-informed approach to selecting the licensing basis events, right?

That's what you are talking about.

MR. BENNER: Well, and I think that's part of our concern is that we see in the approach being proposed that it -- that it does have the use of probabilistic criteria --

CHAIRMAN APOSTOLAKIS: Yes.

MR. BENNER: -- where we're saying in the risk-informed approach idea that, well, you need to have some deterministic portion that --

MEMBER KRESS: Yes. And my point about defense-in-depth needing a new interpretation had to do with if you just look at the, say, frequency consequence type thing to get a selected event that you design against, I think you have to look very strongly at the uncertainties associated with each frequency, its contribution to the uncertainty. And you can't just use the number as is, and that's where you go a little deeper in your defense-in-depth theory.

MR. KING: Yes, I agree. What confidence level do you want? And, you know --

VICE CHAIRMAN BONACA: Well, and there has to be the balance there, because, I mean, again, I want to say that for extreme events that often times one could say you can't rule it out, the -- the

assumption of those events, in the current generation of plants, led to -- to the design of certain parameters that served us very well for more probable events.

I'm trying to say, for example, all of the characteristics that we implemented in -- for negative coefficient reactivity, and so on and so forth, there were results of some evaluation of extreme events that we thought were very improbable or unlikely and maybe couldn't happen. But the fact that you assumed it purely for the purpose of certain characteristics of the reactor, that it served you well for less severe accidents that are more probable.

So I think it's a very -- it's a very critical area, this one here.

MEMBER ROSEN: But you will acknowledge the trap in that as well.

VICE CHAIRMAN BONACA: Of course, I'll acknowledge the trap. I'm only saying that in design -- when you design something, you don't assume necessarily only what is going to happen. You assume you bound certain conditions so that you can define coefficients and certain characteristics of the plant that will serve you well for less severe but more probable events, and --

MEMBER ROSEN: But never assume the vest of invincibility simply because you have --

VICE CHAIRMAN BONACA: Of course.

MEMBER ROSEN: -- created some design basis events, and, therefore, everything less than that is okay. We know from bitter experience that that's not true, that you have to go event by event and think -- and think each event through.

VICE CHAIRMAN BONACA: Well, and say that you do that, and --

CHAIRMAN APOSTOLAKIS: Right. Let's come back to these fellows. Anything else you would like to say?

MR. KADAMBI: I think we're about ready to wrap it up.

CHAIRMAN APOSTOLAKIS: Very good. Have you wrapped it up?

MR. KADAMBI: Well, unless there are any questions, I believe that we are done.

MEMBER WALLIS: My feeling is all of this sort of theoretical. It's an approach, and I think that if you start looking at specific events which are unique to this particular system, like if we're getting into the compressor and there's a loss of compressor accident, what happens, see whether you can

handle it using some of the ideas you've got here, or whether you come up against something else which you haven't thought of that you have to think about at the fundamental level.

MR. BENNER: And that's what we've tried to feed back to Exelon, that we may not need a complete design to start exercising this approach, but if we wanted to take some -- you know, some select event and determine what --

MEMBER WALLIS: There's things having to do with water reactors that you have to think about, just see how far you can go. If you try to use -- apply some of these things, you might find --

MR. KADAMBI: The only thing I would add is that this exercise was, you know, put into practice for the HTGR to some extent. You know, they did go through what they call bounding events which were not proposed by DOE at the time. And, you know, it provided sort of a check of how well did the design accommodate or take -- tolerate these things.

So that's -- Mr. Chairman, that's our presentation.

MEMBER KRESS: Well, I think -- personally, I don't see the need for a letter at this time. I think we've made -- given some feedback with

our comments, and I don't know having them in a letter would be any more useful to you.

So I look forward to continuing the conversation with you as you get further along in this. I personally think you're at least asking the right questions. And so --

MR. KADAMBI: Thank you very much.

CHAIRMAN APOSTOLAKIS: Thank you. We will start the interviews with the candidates half an hour from now, 12:40.

MEMBER WALLIS: George?

CHAIRMAN APOSTOLAKIS: Everything has been shifted.

MEMBER WALLIS: George?

CHAIRMAN APOSTOLAKIS: Yes.

MEMBER WALLIS: Could you tell the membership that the staff is going to --

CHAIRMAN APOSTOLAKIS: Yes. Well, go ahead. Go ahead.

MEMBER WALLIS: I had a telecon with Exelon and GE about this business of the distribution of flux and fuel, and so on. And it turns out that it's a real jungle. It isn't the simple matter at all to say there isn't really flux flattening. There's a very, very complicated fuel management program

necessary in order to meet the regulations. It's not -- there's no simple explanation that you can put in a few sentences and put in a letter.

And the staff agreed to come at 3:00, and in 10 minutes or so tell us how, with all of this complicated stuff going on, can they assure themselves that the core uprate -- this power uprate is okay.

CHAIRMAN APOSTOLAKIS: And also, I remind you, the Commissioner is coming at 2:00. That's why we have this flexibility.

MEMBER ROSEN: He is pushed back a half hour.

CHAIRMAN APOSTOLAKIS: Yes. His assistant was here. He heard us talk about it, and I said absolutely. He called the Commissioner, and he said, "I'll come half an hour later." So the ACRS will have -- Dr. Ford will have more time to run over time.

(Whereupon, at 12:14 p.m., the proceedings in the foregoing matter went off the record for a lunch break.)

CHAIRMAN APOSTOLAKIS: Can we start before 2:00?

MR. MCGAFFIGAN: Is Graham Wallis still here?

CHAIRMAN APOSTOLAKIS: He's coming.

MEMBER POWERS: Yes, George. You may start before 2:00.

CHAIRMAN APOSTOLAKIS: We are back in session. We are very pleased to have Commissioner McGaffigan with us for an exchange of views.

So we'll let you go first, Commissioner.

MR. MCGAFFIGAN: Well, thank you. You can see I've shown up with a blank piece of paper, so I don't have long remarks to make. I'm here more to play a reverse role. We get to sit in the Commission meeting room and ask you questions, so I'll make myself available so you can ask me questions. Hopefully I will do as well as you guys do before us.

I will preface it. I just heard Dana talking about I guess some of the discussions you had this morning about cracking and control rod drive mechanism housings and whatever. There are some issues that are going to come before us I am not sure you are fully on top of. That is whether we are going to shut down some people early by order. Davis-Besse was before you. They are probably the one with the most at stake. There's one other plant that staff hasn't reached resolution with. Earlier we were arguing with some plants over ridiculously small numbers of days, but I think in Davis-Besse's case we

are arguing about 100 days or so compared to when they would like to go into their outage, and we might force them into an outage.

I am not an expert about control rod drive mechanism cracking. I do know that we have some additional -- just orally, we have some additional data from TMI in recent days. All the cracks were axial, not circumferential. They were axial. They are just going to be ground out, and that is going to be it.

I don't know where things stand, to be honest with you, except that the staff is working on this sort of two-parallel path process. One, trying to negotiate with these two licensees who remain in their bullseye. The other, drafting contingency orders for ordering early shutdowns to do inspections that they feel are appropriate, and I think we all would like to have inspection results.

It's a fairly profound question, whether you order somebody down early. So if you all have any comments for me on that or for the Commission as a whole, nothing is going to happen until the end of December. It would be interesting for us to hear those comments and understand your perspective. This is a sort of hard technical issue that's exactly up

your ally.

MEMBER POWERS: Certainly the Davis-Besse folks came in and made a probabilistic argument to us today on why they should not be. I guess I look at it a little bit and say well, OConee ran for at least half a cycle with these cracks. Why do I want to worry about 90 days, or maybe it's 120 days?

MR. MCGAFFIGAN: As I understand, again, I have heard these arguments. The staff argument is that in an ideal situation, they would have liked to have already had the data. So it is a matter of giving them an extra 90 days beyond where they feel comfortable.

As I understand it, the issue has to do with the rapidity with which the circumferential cracks might grow. There is a range of possible numbers. The staff is taking a very conservative number in the absence of data. They admit, and I think it's just true that there isn't a lot of data. I think they also, as I understand it, would like to have some data. What licensees are doing is they find anything, they are just repairing it and getting on with it rather than stay in outage to do science projects.

MEMBER POWERS: My initial reaction is to

say their number isn't all that conservative. It's what I would have picked. Then I realized I am very conservative so --

MR. MCGAFFIGAN: As I say, it's an issue that I think as you guys think about this stuff theoretically, there is this -- the way the staff process works is if they don't get to yes, with the two licensees, they will come to us with an order and we'll have sort of five days of negative consent on which to think about whether we want to go along with that order, because an order is an enforcement action. For high visibility enforcement actions, that is the process that we -- so there isn't a Commission vote on it unless the Commission chooses to weigh in. I doubt the Commission would weigh in unless there were strong technical arguments on the -- you know, that were presented to us as to why the staff was being overly conservative and we could wait the extra 90 days or 100 days, whatever number of days we are arguing about.

I don't necessarily want you to tell me the answer right now. It's just of all the technical issues -- you know, most of the other issues honestly before us at the moment start and end with security and physical protection. Everything else is done on

the side as we have time, but we are fairly consumed with the September 11th follow-up. I don't know whether the staff has talked to you about -- and much of that is appropriately classified and we wouldn't be talking about it in this room. I think you obviously all have clearances. I think there could be a role for ACRS in thinking about design-basis threat adjustments and other things. You know, obviously if we were to do rulemaking with regard to enhancing security at say spent fuel pools and ISFSIs, you all see rulemakings and can comment on them.

MEMBER KRESS: We do have an interest in this of course. We have one of our staff members taking part in most of the activities that are going on. He is going to brief us later today I think.

MR. MCGAFFIGAN: In a closed meeting?

MEMBER KRESS: In a closed meeting. Then we will of course have some subcommittee meetings later on.

MR. MCGAFFIGAN: Yes. We are trying to figure out how much funding we have in this area. We have made a submittal to the Office of Management and Budget for some of the funds that are at the President's discretion. We will need some significant funding. There have been provisions.