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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

JOINT MEETING

MATERIALS AND METALLURGY

AND

SEVERE ACCIDENT SUBCOMMITTEES

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WEDNESDAY

MARCH 5, 1997

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ROCKVILLE, MARYLAND

The Subcommittees met at the Nuclear Regulatory Commission, Two White Flint North, Rom T2B3, 11545 Rockville Pike, at 8:30 a.m., Robert L. Seale, Chairman, presiding.

MEMBERS PRESENT:

ROBERT L. SEALE	CHAIRMAN
MARIO H. FONTANA	MEMBER
THOMAS S. KRESS	MEMBER
DANA A. POWERS	MEMBER
WILLIAM J. SHACK	MEMBER

ACRS STAFF PRESENT:

Noel Dudley

Richard P. Savio

Sam Duraiswamy

Michael Markley

Paul Boehnert

ACRS CONSULTANT PRESENT:

Ivan Catton

ALSO PRESENT:

Jack Strosnider

Brian W. Sheron

Joseph Donoghue

Steve Long

Tim Reed

Jim Myer

Rick Mullins

Joram Hopenfeld

A-G-E-N-D-A

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

(8:34 a.m.)

CHAIRMAN SEALE: The meeting will now come to order. This is the second day of the meeting of the ACRS Joint Subcommittees on Materials and Metallurgy and Severe Accidents. I'm Robert Seale, Chairman of the Subcommittee.

The ACRS members in attendance are: George Apostolakis, Mario Fontana --

MEMBER FONTANA: George is not here yet.

CHAIRMAN SEALE: That's right. George isn't here. I'm sorry.

Tom Kress, Dana Powers, and William Shack. The ACRS Consultant in attendance is Ivan Catton. That's an old echo, isn't it? Eight years old.

The purpose of this meeting is to hold discussions with representatives of the NRC staff to gather information concerning the technical basis and regulatory analysis associated with the steam generator tube integrity rule and related regulatory guide.

The subcommittee will gather information and analyze relevant issues and facts and formulate proposed positions and actions as appropriate for deliberation by the full committee.

Noel Dudley is the Cognizant ACRS Staff

Engineer for this meeting.

The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in the Federal Register on February 14, 1997. A transcript of the meeting is being kept and will be made available as stated in the Federal Register notice.

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

We have received no written comments from members of the public. One individual has requested time to make an oral statement at the end of the meeting. Today the committee will hear from the staff and its contractor regarding the regulatory analysis.

As I indicated to the members of the subcommittee yesterday, we have a reprise of prior comments in this general area based on our letter -- or our report of November 20th and other -- well, the minutes of the January 9, 1997 subcommittee meeting, and the November 5th and 6th subcommittee meeting, and a meeting back in June 3rd and 4th; also some comments from discussions of SCDAP/RELAP5 code.

We want to go over those comments today toward the end of the meeting to determine which ones of them are

still appropriate. Some of them, I think, are moot as a result of the position that the staff has outlined to us. We'd also like to get a little bit more specificity as to where the staff expects to go from here from them later on today.

We don't have a meeting with the full committee scheduled for this -- for later this week. There is a meeting scheduled -- or presentations scheduled in the April meeting of the full committee. So we won't be having a letter coming out at this time, but we will be having one shortly.

With that, I'll call on Mr. Tim Reed, the Office of Nuclear Regulation, to give us the second half of his marathon, I guess, after the presentation that Joe gave us yesterday.

MR. REED: Yes, I guess actually I had finished my presentation yesterday, but there were some comments from Dr. Powers. So what I plan to do is go back to the real guts of the presentation. And the contractor is here today; hopefully can answer your questions.

Get you back -- rebaseline you here. This is where we started getting into the details of it. This is the general net value equation that was used with the five values and the two costs.

As I mentioned, three costs -- three values

dominated the calculation, those involving avoided public risk, avoided offsite property risk, and avoided onsite financial risk. And then the two costs -- of course, the cost to the licensee is dominant in that equation.

The real questions then started with slide number 11.

I believe, Dr. Powers, your question was with regard to the use of the SST1 value and, you know, basically how we were using it to take the Surry answer and translate it into the other 73 PWR's. I'll just let you -- if you want to go through your questions, I have Jim here to --

MEMBER POWERS: Well, if you were calibrating the consequences against the analysis for a particular plant, you would just take source term divided by source term and not multiply by the ratio of the power level. If, on the other hand, SST1 sub Surry is some arbitrary source term applied to the Surry site compared to the same source term applied to the Ith site, then you need to put the power ratio in.

MEMBER KRESS: If the source term is presented as fraction of inventory. That's what they meant by source term.

MEMBER POWERS: No, it's consequences actually. These are -- in fact, I think they said in the

presentation yesterday they were latent fatalities which a little bit surprised me because I thought that prompt fatalities were more limiting.

But be that as it may, the question really boils down to what's the first ratio and why does it have to be multiplied by the power ratio?

MR. MYER: This is Jim Myer from Scientech. I think I can answer that question.

The original NUREG/CR-2239 was an analysis at each site at a given -- I believe it was 3,500 megawatt power level.

MEMBER POWERS: Jim, that's the siting study?

MR. MYER: That's the siting study. It was done by Dave Aldrich at Sandia.

And we normalized the analysis at each site assuming a conditional consequence at Surry and then going to that document to determine the ratios both of power level and of site characteristics to properly accommodate the fact that the SST1 study was done for a nominal 3500 megawatt plant.

And then properly ratio'd it for each unit, the difference in power level which, of course, is then a radiation source term and the difference in the demographics and the weather and the population.

MEMBER POWERS: So my understanding is that

the first ratio really speaks to the characteristics of the site, and the second ratio speaks to the characteristics of the reactor?

MR. MYER: That's correct.

MR. REED: Did you have any other questions from yesterday that I can go through?

MEMBER POWERS: Not on that ratio.

MR. REED: Okay. Let me just draw up the next equations and see if -- several slides and see if that -- if you recall. I'm actually today not recalling any questions on these.

Same ratios being used here to take averted offsite damage in dollars and translate into those 73 PWR's again by this siting ratio and this source term ratio.

MEMBER FONTANA: This discounted life time, is that -- that's a present value calculation?

MR. MYER: Seven percent -- assuming a seven percent?

MEMBER FONTANA: Yes. Now if you've got a plant life extension, because that's on the tail end, that --

MR. MYER: Relatively small addition. But we did not accommodate that.

MEMBER FONTANA: Okay.

MEMBER POWERS: There's a question that comes up in regard to this calculation, and we know what the bottom line on this calculation is. So it's a little bit unfair to bring it up here because I don't think there's any way we can easily change your final conclusion by manipulating these equations.

It's a fairly robust equation. But when you look at a thing like delta LERF and the way it is calculated for a general PRA, you're looking strictly at the internally initiated accidents. And you're not looking at the incremental effect due to externally initiated reactor accidents.

Or are you looking at shutdown? And I don't think shutdown enters into this particular calculation, but in a general calculation it will. I do know even that the external events will enter in here. And even if they do, all they're going to do is double your LERF, it seems to me, roughly. Double it.

And that's not enough to change your equation conclusions. But there's a problem approaching it this way with LERF. And the problem comes about because in the external events, delta LERF, the way it's calculated especially in the shorter methodology, moves out a group of accidents that can have high consequences because you can't evacuate in a seismic event.

And of course, if you don't calculate the external event probabilities, it's not reflected at all.

MEMBER KRESS: You're saying when you define the sequences you use to determine LERF for seismic events, you ought to use a different set of them because of the -- your relationship between warning time and evacuation changes?

MEMBER POWERS: That's right. And if you recall the shortcut methodology, that they went through and they said -- they looked at all the sequences and they said what fraction of these sequences result in early release.

MEMBER KRESS: Right.

MEMBER POWERS: And only that fraction was included in the definition of the LERF.

MEMBER KRESS: That's right, right.

MEMBER POWERS: Okay, the trouble is that that fractionation now changes if you have a seismic event. It changes in ways that are probably site specific. Changes in ways that are not obvious from the internal sequence of events.

MEMBER KRESS: Sure sounds like a bit tough thing to try to --

MEMBER POWERS: Well, I think that's one of the flaws in the shortcut methodology is it's very

attractive for internal events.

MEMBER KRESS: When Level 3's are done to calculate risk using the full Level 3, is that taken care of in seismic events? Is that factored into the --

MEMBER POWERS: I think it depends on the skill of the analyst.

MEMBER KRESS: I see.

MEMBER POWERS: Now, you clearly can. Because in the usual consequence approach, you have an evacuation time. You have evacuation routes that are at the input -- at the disposal of the --

MEMBER KRESS: So you could just change that evacuation time?

MEMBER POWERS: And so you can -- and in fact, there are accommodations built in for earthquake type of things that allow the user to specify a certain category of things and then the code takes care of the rest of the formula. It's not been an area of great deal of discussion because it is true that if you influenced those evacuation routes and evacuation capabilities very much, the fact that you're having a nuclear power reactor accident may not be your biggest concern.

CHAIRMAN SEALE: But that goes back to this whole question of the quality of the PRA.

MEMBER POWERS: Yes. I mean, --

MEMBER SHACK: But in this calculation, I mean, it wasn't done with the 1061 method. And I don't think they threw those -- they didn't eliminate those sequences in this analysis.

MEMBER KRESS: Well, that was the question I was going to ask. Did they use the 1061 definition?

MEMBER POWERS: They have used a strictly -- an internal events calculation that's available for Surry.

CHAIRMAN SEALE: There's another --

MEMBER POWERS: Actually, to be perfectly honest, what they did was they used the -- as I understand it; correct me if I'm wrong here -- is they used Surry multiplied by all the factor to get it -- the number up a little bit from 3.9 to 4.5 or something like that times 10^{-5}.

CHAIRMAN SEALE: There's another -- as I understand it anyway -- difference in the offsite damage calculation. And that is that you're -- as you pointed out earlier, the externals of the site. That is, the demographics and the meteorology are in the SST ratios.

And that ratio I cite to Surry for source term is not necessarily -- that is for fatalities, in the earlier -- in the V1 calculation is not necessarily the same ratio when you start talking about property damage because, in that case, it's meteorology and long term

value of the -- of accessibility to the property.

It's not population distribution. So corn fields are different from desert or whatever.

MR. MYER: That's correct.

CHAIRMAN SEALE: So that's a kind of a squishy -- but again, it's not enough to make any difference in the answer.

MR. MYER: What we did here is a relatively simplistic approach to the issue.

CHAIRMAN SEALE: Yeah, sure.

MR. MYER: And we had done some sensitivity analyses that show that it isn't a big impact on the final conclusions.

MEMBER KRESS: I'd like to return to your earlier question, Dana, about why use the latent effects as opposed to the prompt. I'm not sure I know the answer, and I'd like to know if --

MR. MYER: Well, the 50 mile latent person rem that was used is, as you're aware, a standard measure of consequences. And again, it was the streamlining -- it was efficiency on our part to use that value -- use that metric and then always have available to us the ability to do sensitivity analyses by determining impact of such things as some of these other things that come into play.

MEMBER KRESS: Does that metric maximize the

offsite costs that you would divert?

MR. MYER: Well, no. And it's quite right that if we, for example, included external events and included early fatalities, that number would go up.

MEMBER KRESS: Well, no; I mean as opposed to using some other metric like the early fatality cost.

MR. MYER: Generally they'd be about the same. I don't think that -- if anything, I think they would be a bit smaller. But, I mean, the guidelines recommend the 50 mile person rem as the metric.

MEMBER KRESS: That's built into the regulatory analysis guidelines?

MR. MYER: I believe it is.

MEMBER KRESS: I see.

MR. MYER: I'd have to double check.

MEMBER KRESS: I guess I didn't remember that.

MEMBER POWERS: I continue to have concerns about the metrics for consequences that get used when you use a single metric. And one of my concerns is that -- for instance, here where they use the latents, they use latent fatalities. I think that that may be an under estimate of the risks.

That it may be useful also to look at not only latent fatalities, but latent injuries as well. And I'm reminded of that because when we look at the Chernobyl

accident, we have a substantial amount of latent injury that are not classed as fatalities.

And that's all the thyroid cancers. They're not going to result in fatalities, but they're injuries that are not -- that are costly to address. That's a different issue from this, but it's an issue that we need to think about when we think about risk informed regulation when we're not using more risk; we're using these subsidiary measures.

Again, you're not expected to respond to these.

MR. REED: I understand.

MR. MYER: These are valid points. And like I said earlier, we did a very straightforward analysis. And it is a measure. And as long as we understand what the implications of that measure are, we feel comfortable.

DR. CATTON: They resulted from a human error, didn't they, Dana? They resulted because the mothers continued to suckle the babies when they were told not to. That's human error.

MEMBER POWERS: I don't have that intimate knowledge of what went on.

But, Jim, one of the questions that arose yesterday was we -- we will in a few slides here get down to a -- the 700K per plant positive value with all the

appropriate constraints on it and limitations to it.

And the question I asked was, at what higher value would you have said that it was worthwhile to go through and do a more detailed analysis? You've got a relatively low value for the benefit here in a fairly generous calculation, and you saw that there was no value in going in trying to refine the calculation.

And I was curious at what level would you have said a refinement would have been needed?

MR. MYER: Well, if it came out that per plant the value was in the range of two to three million dollars, four million dollars, I think that procedural fixes -- range of about a million dollars or five hundred thousand to a million.

On any hardware fix, as I'm sure you're all aware, this is upwards of three, four million dollars and beyond. So that would be kind of a very rough, coarse measurement of that threshold.

CHAIRMAN SEALE: Could we do that a little bit later?

MEMBER POWERS: No.

CHAIRMAN SEALE: Richard, they were in the middle of a conversation.

Go ahead.

MR. MYER: I was done.

CHAIRMAN SEALE: Well, I don't think Tom heard all of what you said.

MR. MYER: A very rough estimate of the threshold, more detailed analyses would be appropriate. In my opinion, it would be -- if you're talking procedural fixes, in the range of five hundred thousand to a million dollars per plant. And if you're talking hardware fixes, anything upwards of two million dollars a plant -- two or three million dollars.

And again, it's a rough call, but a reasonable measuring point.

MR. REED: Just to remind the committee that this calculation came out with a positive 700 with the exclusion of a major cost there, so the actual net value's certainly much smaller. If you came out with a net value then. That's what Jim's talking about.

MEMBER POWERS: Now again, I think you're probably right about that and that your conclusion is relatively robust. We haven't found anything that -- I can find things that move things by factors of two. I can't find this factor of ten and it's probably necessary to have more like a factor of 20 or 30 before you can make any change or refinement.

There's just nothing there to be found.

MEMBER SHACK: Just out of curiosity, what

happens when you are dominated, as you appear to be here, by a relatively small number of reactors? Suppose this had come out that you had a net benefit, that it was really due to high risk reactors?

MR. REED: My first -- probably of the top of my head is I would go back and look at the assumption. We made a pretty bounding assumption for those ten. First thing comes to mind is, you know, you wanted to look at the top worst ten. We didn't throw in the bottom -- the good guys.

You know, if you really want to look at a spectrum of what the reactors are out there, you want to try to look at the entire range, what it really is. I would try to refine that assumption and try to more directly model what's actually out there.

MEMBER SHACK: I guess my question was can you really impose a backfit on everybody?

MR. REED: You can impose backfits on a subset of plants.

MEMBER SHACK: I mean, would you use these ten as an excuse --

CHAIRMAN SEALE: A large enough sample.

MEMBER SHACK: -- as a justification for a backfit on everybody when really everything was dominated by the ten.

MR. REED: By an assumption for ten, yes.

DR. SHERON: No, I think quite honestly that we would --

MEMBER SHACK: You would single out the subset?

DR. SHERON: If we thought the ten plants, for example, were really driving it, okay, my guess is that even if we went forward with a backfit, you know, for a public comment process, we would hear a lot of kicking and screaming from the industry and the like.

What we found over the past years is that there's no such thing as a generic backfit. And that's been difficult because then you have to deal with each plant on a plant specific basis and what might be the best solution for a particular plant.

There's a lot of ways to address this. You know, as we pointed out -- I think I pointed out in my presentation yesterday was that one way to do it is you drive the frequency down. If the event that's driving this is a station blackout, obviously if you can improve reliability of your AC power sources, that might be one way to solve the problem.

MEMBER SHACK: Okay, a guy that already has his frequency down has already essentially complied with the requirement?

CHAIRMAN SEALE: But that raises a very interesting question. And that is, why not go ahead and do a risk benefit on the ten high risk PWR's here? You have most of the numbers. And if indeed these plants have some opportunity to disqualify themselves from that list, that might not be a very bad thing to push for.

MR. STROSNIDER: This is Jack Strosnider from the staff.

I guess one comment I'd make that I think you need to consider in that is that the plants that might contribute to this risk are changing with time. As a plant replaces their steam generators, they're less of a concern as another plant as their generators age and degradation begins to occur. So it's not always the same ten plants at any given time.

And this was just sort of an estimate of how many plants at one point in time might be in a high risk category. I think that's a fair characterization. But that does add some bit of difficulty to that sort of assessment.

CHAIRMAN SEALE: I appreciate that. But on the other hand, this is certainly potential ammunition for the operators of those plants to help them make those decisions that might move them out of that list somewhat.

MEMBER SHACK: I mean, since the 700K is

averaged over everybody, I mean you get a very different value, if you will, if you stuck with the ten.

MR. REED: That's right. This assumption results in -- you know, most of the 700K come from the ten guys that you assumed had almost nothing. If you're an average plant out there, you have almost nothing even with the bounding delta LERF.

So, you're right. What I think we'd have to do is go back and actually start looking closely. I mean, we did a rather brief survey of the IPE's and where they stood. And then you have to look and say well, where are these guys really in terms of large early release; and do these guys have bad generators and start thinking about where they stand and looking a lot closer at those plants.

MEMBER SHACK: I'd go back to Brian's statement that it's really very hard to come up with a generic backfit. There's enough -- look at that scatter in those plants on that bar curve. I mean, you know --

MEMBER FONTANA: If that's ten out of 70 plants, just multiply it at 700 by seven and you get 1.4 million, and that's not going to change your conclusion, I don't think.

MR. REED: Yeah, it will be probably a couple million, I mean, per site for those ten and nothing for the rest of the guys.

DR. CATTON: That's why you want risk based.

DR. SHERON: As I said before, any hardware fix, I think, is going to be in the tens of million dollar range. And even to fix procedurally, as I said -- you've got to look at the down sides of something, for example, like a depressurization scheme. Okay, a lot of analysis is involved.

It may not even come out. It may even show that there are negatives that would offset, you know, any positive benefits. So I think -- and even if you're up in a couple million dollar range, you could eat that up just in the analysis that would be required.

MR. REED: In this particular circumstance, --

MEMBER POWERS: Seems to me that this -- what you're addressing here are the risk dominant accidents for large classes of PWR's and you've taken kind of a bounding estimate on that risk. And you come back and conclude that you can't make a hardware fix. And I think that that conclusion has wider implications.

It means that there probably -- that for plants that currently meet the safety goals, you're just not going to find hardware fixes for them. They are, by definition, safe enough.

MR. REED: Even in the low 10^{-6}'s. That's the number out here just in this one piece.

MEMBER POWERS: And unless you find something that is a flaw not only during normal operations, but a flaw during shutdown operations and a flaw during external events, which -- and I don't think your steam generator falls in that category because I think it has limited application to the shutdown situations.

MR. REED: That's right.

MEMBER POWERS: But unless you find something that is a flaw that has impact through all modes of operation, you're never going to find a hardware fix. You may find some procedural fixes, but you're not going to find a hardware fix.

DR. SHERON: Just for a calibration point, you know, I was on the CRGR for four years when I was in the Office of Research. And I would probably -- I would guess that about 99 and nine-tenth percent of all of the issues that came to CRGR were compliance backfits and not enhanced safety, recognizing that the enhanced safety backfit requires the cost benefit analysis -- the compliance backfit doesn't.

It just says that there's existing regulations and we think you need to do some more to maintain your compliance with those regulations. Very, very difficult, okay, given the -- not only the guidance on, you know, what constitutes, you know, roughly $2,000 a person rem to

go forward with any kind of a backfit.

But most plants meet the safety goal, okay.

MEMBER POWERS: And we've got a consistent set of regulations. I mean, our backfit calculation is consistent with our safety goals.

DR. SHERON: The other way to look at this too is that we're saying that the risk associated with steam generators from a severe accident standpoint is not excessive from the standpoint that we need to do something. It's saying that it's still in an acceptable range.

MEMBER FONTANA: It's not dominated by what you could do with the steam generator because the severe accident that clears the loop seal could also damage the pristine tubes like we said yesterday.

DR. SHERON: Yes. And the only thing we're saying now is that there's still a question mark if a licensee decides to do some -- wants to use a management scheme that involves the relaxation, okay, and where they may increase their flaw distribution of deep flaws and so forth.

That would have an impact on risk, okay; and they need to [illegible] that before they go ahead and do it. Because remember, you know, we still are dealing with not only the primary system pressure boundary, but the

containment boundaries. And that's really what's making this a unique item here.

MEMBER FONTANA: Yes. If you don't change anything, would the licensees have to plug tubes on detection?

DR. SHERON: Unless they have --

MEMBER FONTANA: I mean, if you don't change anything at all?

DR. SHERON: It depends. If a licensee has developed the qualified method for sizing cracks and can demonstrate, for example, that they can size a crack, and they can show that a crack is either less than the 40% through all criteria, and that it won't grow to beyond an acceptable structural limit by the end of its cycle, then yeah, they could leave those cracks in service.

They're not required to plug. But if they can't make that demonstration, then they have no choice.

MEMBER FONTANA: Well, that's quite a thing to have to demonstrate because --

DR. SHERON: Some licensees have already done it.

MEMBER FONTANA: But the thing that I haven't seen is the linkage between what the crack looks like and the vulnerability of that tube under certain kinds of -- various temperature and pressure loads on it. That data

base looks kind of sparse to me.

DR. SHERON: Well, that's what they've been doing at Argonne is looking at, you know, how these tubes behave with various forms of degradation to see how they would perform under a severe accident condition and see how well our models predict.

MEMBER FONTANA: Where I was leading is on this -- if they have to end up plugging a lot of tubes, isn't it to their advantage to take the initiative to either -- well, either take the initiative to run with a flawed steam generator or buy a new one?

And I guess there's a real incentive there to take the initiative so that they could operate with more flawed tubes.

DR. SHERON: Right. A lot of it depends on how they manage their generators. In other words, if they see accelerated degradation -- okay, and let me take the case of Byron and Braidwood. Okay, there's two plants that have generators that I think they're in a race between when they get to a point where they just plug everything, okay, to when they can get the new generators on site.

And they've tried to, you know, move up their schedule for the replacement and the whole bit. They're in mid-cycle outages now and they're seeing -- every time

they go in and look they find a lot of degradation, new indications.

One of the things that we're trying desperately to do is to demonstrate, for example, on circumferential cracks at the top of the tube sheet that they could correlate those to a voltage and thereby leave in service. That was one approach they were trying to get the staff to approve.

The voltage based criteria we use for the older generators, the Westinghouse generators, at the tube support plates. That was a case where cracks could actually be a through wall crack, okay, and thereby violate their current tech spec criteria, yet not pose any kind of a risk from the standpoint of a structural defect that would fail.

And what they did is they did a lot of testing and a lot of tube pulls and demonstrated that you could correlate with the voltage to a burst pressure and a leakage. And they demonstrated that it's totally independent of depth now.

Okay, so there's a case where they said I'm not going to worry about depth. I'm just going to correlate to a voltage, and I will show you that -- you know, and I think the committee was a little concerned that there was no physical relationship there.

But the fact is, it worked.

MEMBER FONTANA: Did it get approved?

DR. SHERON: Yes.

MEMBER FONTANA: Yeah, okay.

DR. SHERON: Yeah, now they'd like to go to higher voltages. And we said fine. You know, I mean, if you submit the data that supports it, you know, we'll be glad to look at it.

MEMBER POWERS: You were going to discuss turning the equation around.

MR. REED: Well, actually I was going to -- that's what I was leading into actually when you -- you know, when you go from trying to impose risk on somebody to saying okay, now if you relax something, you need to consider risk, economic motivations are completely different.

And you know, some guy who finds his generator falling apart -- thousands of indications suddenly pop up on him in an outage; at that point, he can't get a replacement generator obviously very quickly. He's probably looking at years. He's going to want an alternate repair criteria.

And at least the structure that we build into this enables him to at least try to pursue that approach. Develop an alternate repair criteria and then do something

with the risk. And you know, my own experience, my own past experience at one time in my history in this industry being aux. feedwater system engineer, I look at it and say, you know, that these problems get solved with water on the generator.

Every single transient that's out there goes away, poof. So if you can improve the -- for example, your reliability of water and keeping water there, whatever you have to, with more batteries or whatever, improving the liability of the AFW, what you've done is, in fact, you've reduced the frequency of these events.

You've driven them down and you can get -- address the risk in that manner. Now, I guess you'd still have to go through and crunch through the numbers and large early release and show in fact that you did make the change. So it's still not a trivial effort.

But at least the structure is there for the guy to pursue that. And his economic motivations in that are obviously -- can be very large. I mean, he could be looking at losing his site -- shutting the site down if he's got to plug everything on detection.

So I think that's an -- I mean, that's certainly good that we've built into the process. You know, at least he's able to pursue alternate repair criteria by allowing this guy to do something in terms of

risk so that he can hopefully be successful in that.

But, you know, I think as you said a little bit earlier, Dana, when it's on us, when we decide we're going to pose a regulation on somebody, we have a whole different set of criteria. And the $2,000 per man rem, it just doesn't come out.

When the guy's looking at tubes that each one's so many megawatts or whatever, you know, that's a lot of money. And he's willing to do a lot in terms of spending money if he has to unfortunately.

DR. SHERON: I was just talking with Jack.

Just for your -- we think right now the two areas where if this rule were -- or not the rule, but this regulatory approach were in place where a utility might have to deal with it is in circ. cracks at the top of the tube sheet and free span cracking if they wanted to go beyond the current 40%.

One thing they might do is for free span is just say we can qualify probes to depth size to our current tech specs. But if they wanted to use some alternative type of criteria, at that point, we would probably say you need to look at the risk associated with whatever you're going to propose.

So these are the two areas we think there will probably be most interest in, you know, in the immediate

future. Because that's really what seems to be where the problem areas are today.

MR. REED: Is there any additional questions on the regulatory analysis from yesterday while we have Jim here?

MEMBER FONTANA: You've got a minor typo here.

MR. REED: Because I wanted to start up. I know you had several questions that we couldn't answer yesterday. I think that's all that I can -- I don't have any more written on my slides actually, so the rest of it was talking about the implications for the rule and how we deal with it.

If not, I guess we can -- Chairman Seale, I guess we can get onto the next item.

CHAIRMAN SEALE: Sure. Well, you have certainly done violence to our schedule. I would suggest that -- you're going to be talking to us next June?

DR. SHERON: Well, I have a list of -- I think we had decided that maybe what we could do at this point, rather than me summarize, would be to go through the list --

CHAIRMAN SEALE: Yes.

DR. SHERON: -- of remaining issues.

CHAIRMAN SEALE: Okay, that's fine.

DR. SHERON: You know, if we could discuss

those and see what more the staff needs to do to address them.

CHAIRMAN SEALE: If you want to go ahead and -- you have a list, you say? Is it a compilation of concerns?

DR. SHERON: Actually, I have your compilation.

CHAIRMAN SEALE: All right, fine. Well, we were getting some stuff -- a viewgraph made or two, but that's all right.

The list starts off with difficulty in reaching agreement on the performance criteria. That is, the list I have. Does that agree with your list?

DR. SHERON: Yes.

CHAIRMAN SEALE: All right. And there were four topics under that, the comparative risk status of the new rule versus the existing rule; the accident leakage criteria as a limit in gallons per day of capacity for the charging pump.

These are pretty scattered topics, as you can tell.

NRC approve or inspect the methodologies used to verify compliance with the criteria; and the level of detail in the regulatory guide. These were all concerns that were identified back at the -- in our earlier

meetings.

MR. STROSNIDER: Yes, this is Jack Strosnider from the staff, and maybe I could summarize the status of this issue at least from the staff's perspective.

The first item under there with the comparative risk status of the new rule versus existing rule -- hopefully in the presentations that you heard yesterday and today, you've seen the approach that we've taken. I think the original question had to do with are you doing a before and after comparison of risk.

And I think what you can see, there's a little -- perhaps a little bit different approach here recognizing that we -- it's very difficult for us to assess the risk that might be associated with some alternate repair criteria that we haven't yet seen.

But the approach we've laid out is that that's something that would need to be looked at at the time it were proposed. So we have looked at the current risk, and you've seen the results of that, the conclusions.

With regard to -- let me go to the last two because I think I can say something about those. The approved -- we had raised, I think, during one of our meetings these issues where were requesting some comments from the committee on the need for NRC to approve or inspect the methodologies used to verify compliance with

the criteria and also the level of detail in the regulatory guide.

And I think one of your letters in fact did response to those. And my recollection is that the committee felt it was appropriate to provide sufficient detail in a regulatory guide to make sure that the performance criteria are in fact being measured properly and monitored properly.

And I guess, quite frankly, I don't recollect exactly what your conclusion was with regard to the need to review these; but I would point out that the framework we've presented in the last day or so here would --

CHAIRMAN SEALE: Yeah, I think you've largely responded to those issues.

MR. STROSNIDER: Okay, see I -- okay.

CHAIRMAN SEALE: What you did yesterday.

MR. STROSNIDER: Actually though, when I go back, there was this agreement on performance criteria. One of the issues that came up was the factors of safety that we were proposing for the deterministic performance criteria.

Since we had that meeting -- that's a factor of safety of three on normal operating pressure and 1.4 on postulated main steam line break. Since we had that meeting and discussion with the committee, we've received

a submittal from the industry with their thoughts on that subject.

And we're actually having an independent review done by some people with expertise and experience in the code. So we recognize there's still an issue there that we want to follow up on, and we will do that if not before this -- we're able to get something out for public comment, at least during that period.

And obviously we'll have to resolve that. With regard to the accident leakage criteria being tied to the capacity of the charging pump, I think the point that we've made in the past is that the intent there was when you're limiting potential leakage under accident conditions, you want it to minimize challenges to the operators and getting into actually accidents or scenarios that were beyond what was in the -- I believe in the current operating procedures.

But perhaps someone from DSSA -- Joe Donoghue could make a few comments on that.

MR. DONOGHUE: Yes, Joe Donoghue from staff.

Just echo what Jack said. We just don't want to have a LOCA complicating a tube leak situation. That was the basic premise for that.

CHAIRMAN SEALE: Now, I want to remind all the members what we're really concerned with here is to

identify any of these issues where we wish to get additional information from the staff before we get our presentation to the committee of your proposed recommendation to the commissioners at the April meeting.

Is there any additional information that we would like to receive before that meeting to help us write the letter at the April meeting in support of -- about what it is you're going to be proposing to the staff?

MEMBER POWERS: I guess I'm a little confused about the next step that they're going to take on this rule. Is what we have in writing now in the reg. guide what is going to be operative?

CHAIRMAN SEALE: Well, you're still in the process of dropping the last shoe, aren't you?

DR. SHERON: Yes. The steps that have to be taken next -- okay, one is that, as I said yesterday, we need -- we are preparing a Commission paper. Hopefully that will go up within the next few weeks which will inform the Commission of the result of our risk assessment and regulatory analysis and propose what approach we would like to take now with regulating steam generators.

The next step would be to put together the entire package which would include -- as I said, there would be a generic letter that would go out. There would be a reg. guide. There will be a report that addresses

Dr. Hopenfeld's concerns.

This reg. guide -- there will also be an overall -- you know, make the linkage to inform the industry of how we would use Draft Guide 1061, for example, and the like.

This would all go out for public comment. Okay, at which time the industry, as well as the public, would have their opportunity to comment on what we are proposing. We would then receive public comments, take them into consideration. My guess is at some point we would be back down here to the committee to discuss, you know, the results of the public comment process and what changes we made, if we made any, to deal with those comments.

Right now, I think what -- obviously what we would like is an endorsement by the committee at some point to go forward with this draft regulatory approach at least for the public comment process. And for that, I think we would like to know exactly what further concerns you need more information on.

And you know, I think the best mechanism to get you that information is to have -- to schedule one more meeting. And we will have the right staff here to present the information that you're looking for.

CHAIRMAN SEALE: And what we want to do now is

to define what it is we'd specifically like to have them present at that meeting.

MEMBER POWERS: And in this -- in all these packages of information, I'm not sure where, but in the package of information, will you include a description of what this understanding you've developed on if you try to use risk to justify anything, what kinds of things the staff will be looking for in those risk assessments?

And you develop that understanding and we heard about it yesterday to a fair level of detail where you understand what the -- what topics should appear in a risk assessment and what the difficulties are with using available data bases to support the analysis.

DR. CATTON: Dana, is this Reg. Guide 1570?

MEMBER POWERS: I think so.

DR. CATTON: Or NUREG-1570. It is? Okay.

DR. SHERON: What we had proposed -- I think I had it in my slide yesterday -- was we would add a section to the current draft reg. guide that Emmett Murphy has prepared that would provide that guidance in terms of if a licensee were to go forward and propose, say, relaxed criteria and therefore had to address the risk associated with it.

This would provide the guidance on the kind of things we would expect the licensee to consider.

Is that what you're referring to?

MEMBER POWERS: Yes, I think that's what --

DR. SHERON: You haven't seen that yet because we haven't written it.

MEMBER POWERS: I know. But we saw the basis of it, and I think that would be one of the topics that --

CHAIRMAN SEALE: We'd like to confirm that that in fact does the job.

MEMBER POWERS: I'd like to see how they summarized their learning and how they interpreted it. Because I think we could -- I think we could help them give a good scrubbing on that. Because they've done a lot of work, and they could probably provide some real useful insights not only for this PRA application, but for a lot of PRA.

Because we're working on the risk dominant accidents here. So what they learn has a pandemic applicability here so that that summary should clearly represent some fraction of the presentation.

CHAIRMAN SEALE: Now we have a problem. When will that document be available?

DR. SHERON: Excuse us.

CHAIRMAN SEALE: I mean, we've got a real problem here.

MEMBER POWERS: Everyone turned around and

looked at one individual who looked down at his shoes.

DR. CATTON: Rob, I missed yesterday.

MEMBER POWERS: You missed a good one.

CHAIRMAN SEALE: It was a good one.

DR. CATTON: So I'm kind of wondering, this list, what kind of comments do you want and -- for example, I think Chapter 3 which deals with the thermal hydraulics didn't really get at the question of uncertainty. And is that a part of what you want to hear about now?

CHAIRMAN SEALE: Well, we didn't really hear about the thermal hydraulics at all yesterday.

MEMBER POWERS: Well, the subject came up and we conceded we didn't have our expert here.

CHAIRMAN SEALE: Yeah, right.

MEMBER POWERS: But they were certainly able to answer my questions. And the questions had to do with how you go -- how much significance do you ascribe to the Westinghouse experiments when they relate to heat up of the -- and radionuclide deposition in the steam generator tubes since the Westinghouse experimental tubes were scale distorted.

And I think we came away from that discussion arguing for the heat up that they were integrating over a sufficiently long portion of the inlet region that

sensitivity studies amounting to 20% of the heat transfer coefficient, if I recall, were adequate -- that I felt that 20% was a little small.

DR. CATTON: Well, my concern was a little different. They either raised all of the heat transfer coefficients or the lowered them all. That's not an uncertainty evaluation. The heat transfer coefficients can be plus or minus something that needs to have a basis.

I would have picked roughly the same range as they did maybe for -- but I think it should -- they should have had a reason. There should be a basis. Why do I choose plus or minus 20%? I know damn well I can't measure it any better.

And then there are other phenomena that come in that may make you want to spread it. That's just a part of it. The uncertainty comes -- or where you get in trouble is if heat transfer coefficient's low and the other is high because we're talking about a race in time.

Now I may have read the report incorrectly; but from my reading and looking at the tables, they either raised the heat transfer coefficient so everything goes in the same direction, and I couldn't figure out what the hell they did with the mixing because there were three things that they varied.

And in the middle of it is some adjustment of

the -- of how they treat the plenum in the code. If this 1570 is supposed to be an example for others to use, I think it's far off the mark. This is a relatively simple problem to deal with. But you do have to deal with plus and minus.

MEMBER POWERS: Now just as a calibration, you also said shut down risk was a relatively simple problem.

DR. CATTON: That's different.

MEMBER POWERS: I just want everybody to understand what the word simple means here.

DR. CATTON: The calibration is really have you done this kind of thing before. No, it just looks easy.

MEMBER POWERS: But you still said it was easy.

DR. SHERON: If I can answer the question.

CHAIRMAN SEALE: The first question.

DR. SHERON: The first question which Dana asked. We will need to get back to you on a schedule. We had a little robust discussion here. We're not of one mind yet in terms of how long it will take to get that section put together.

We need to go back. We will let you know and fairly shortly.

CHAIRMAN SEALE: But it may well be then that

that's not something that we would be able to address in a letter we would propose to write in April.

DR. SHERON: Right. I mean, we'll have to see how soon we can get the package down here.

MEMBER POWERS: Incidentally, Brian, I think that for the April meeting in this particular area, the conclusions you've reached rather than all the verbiage you have to decorate it would be of interest.

CHAIRMAN SEALE: Yes.

MEMBER POWERS: And I think I could write those conclusions on what the sticky points of the analysis are and what elements should appear in the analysis. I could write that right now based on what was presented yesterday because I think it was fairly transparent.

Now the details that Ivan's discussing on where the -- how you treat some of the mechanistic heat transfer and what not in there are among the sticky points. And I'm intrigued by what he has to say.

DR. CATTON: Well, my concern primarily is that if that's to be the guide for other people to use, and you say this is an uncertainty evaluation, that's the problem. The choice of plus or minus values is not.

MEMBER POWERS: It was certainly portrayed yesterday as a sensitivity analysis.

DR. CATTON: And even sensitivity, you should look at the sensitivity to moving one thing up while you move the other down, not everything going in the same direction.

MEMBER FONTANA: There's a sentence in here that seems to imply that the field of sensitivity and uncertainty are the same thing, and they're not.

DR. CATTON: No, they're not.

MEMBER FONTANA: But what came across yesterday is that the sensitivity analysis showed that within the ranges that they were varying things, that other factors would swamp it. And the main thing that would swamp it that I came across to me is the potential for clearing the loop seal and getting hot fluid through all the tubes.

And that just wipes out all the other things.

DR. CATTON: Sure it does. There's no question. You clear the loop seal and you're in trouble.

MEMBER FONTANA: Yeah.

DR. CATTON: But in the other -- see, what you have is a race in time. If I increase the horsepower of both, I stretch both times. What you really need to do is say okay, you're at the bottom of your distribution and you're at the top. Then ask what happens.

MEMBER FONTANA: Well, the impression I got

from looking at this is that this race in time really is pretty close.

DR. CATTON: That's why you --

CHAIRMAN SEALE: That's the problem.

DR. CATTON: That's the problem. That's why you need to look at both directions, not just increase everybody's capability or decrease everybody and ask what happens. All you're going to do is stretch things out or shrink things down a little.

DR. SHERON: I would just like to add that we're not simply looking at the NUREG as the definitive role model for the industry here. This was a calculation, you know, that we did for our own work here. We're not putting this out to the industry to say if you follow this, you know, the staff will bless it off and say it's great.

The industry, you know, depending upon their unique circumstances, their generators and stuff, they're responsible then for doing that assessment. Like I said -- I think Tim may have said it too, and that is that my guess is that most licensees are going to try and avoid at all costs trying to get into this level of detail and justify why, you know, they don't have some sort of an unacceptable risk based on trying to do these detailed calculations.

My guess is they're probably going to go for the first option, which is try and demonstrate that the initial frequency is low enough and the like. But, you know, we're not trying to say that the calculation we did is the role model, okay?

DR. CATTON: I understand that. It's just I don't think it's a good idea to have a bad example out there. It would be better just to take it out.

DR. SHERON: Okay, well we can certainly consider that.

MEMBER POWERS: I think it was -- I think it was a good educational opportunity, and a lot of the things that came out -- a lot of the education that came out of it was they took and compared failure criteria that they would define from data against failure criteria that other people had defined from the data and they found reasons to take exception to what other people had done, areas of controversy.

I thought that was some of the most useful information that came out. Because you get people saying well, these valves are incredibly reliable except when you don't want them to be reliable, and then they're incredibly unreliable.

MEMBER FONTANA: It's got to be one way or the other.

MEMBER POWERS: I mean, you will have people arguing that gee, this valve sustained damage, therefore it's unreliable when I don't want it to be reliable. And on the other hand, in another circumstance, they'll come back and say yes, the valve suffered damage, but it's perfectly capable of doing its function even at massive amounts of damage.

And they were able to show that that had real consequences in their case and there was substantial reasons to doubt those. On the other hand, they were able to find -- they were able to look at data bases and find areas that people thought things were quite reliable.

True enough in the laboratory, but you have industrial experience that says maybe not so true. I think those are very useful. Not definitive, but very useful to alert people they're problems that you've got to confront in doing these analyses.

CHAIRMAN SEALE: Okay.

MEMBER SHACK: Just a procedural question. Under the new approach, would the reg. guide look much as it is and you'll identify in the generic letter those sections which are backfits and those sections which are part of the alternate repair criteria, or will it be somehow rewritten to make it really two separate documents?

DR. SHERON: Well, first you have to understand what the nature of a generic letter is. Okay, it's really a 50.54(f) letter, and there's two kind of 50.54(f) letters the staff can issue. One is where we just ask for information. Okay, basically, as Mr. Moraglia always says, to determine whether we're going to bend, fold, spindle, or mutilate your license.

We can ask for the information. We don't tell them how to get it. That's what I usually call a straight 50.54(f) request for information. The other type which we normally refer to as a generic letter basically tells the licensee, for example, we don't believe you're in compliance with the regulations.

Here is a program or here is a way that we think you need to improve your design, whatever, through procedures, through additional commitments, etc., in order to come into compliance. Please tell us whether or not you intend to follow what the staff is telling you to come into compliance.

Or if not, tell us what you're going to do to address the concern. This generic letter would probably point out that we think that you need to do more to come into compliance with the current regulations regarding the management of your steam generators. Okay, here's a reg. guide that provides an acceptable program for managing

degradation in your steam generators, okay.

One approach would be to commit to that reg. guide the tech spec amendment. Another approach would be if you want to adopt the reg. guide but make certain changes to it, that's fine; come in and tell us about what parts of it you want to change and do differently.

Or, what other approach would you propose to demonstrate you're remaining in compliance with the Commission's rules and regulations in this area. And they could come in and say we're going to rely on some industry document. Okay, and then we would look at that and determine whether that document, okay, addressed the concerns that we had.

We would also be providing guidance with regard to what to do if you want to use relaxed criteria -- if you want to change your criteria. At that point, we would be pointing out that they would need to do an assessment of risk. Okay, the reg. guide would contain a section which would provide the kind of information we would expect them to consider in doing that assessment.

I'd also point them to Draft Guide 1061 or -- if that's out final at the time -- to also consider in terms of looking at what kind of changes in risk the staff would find acceptable versus not. So this is the implementation process.

Now, the licensees could come back and tell us to pound sand, which is a blunt term. Then we have to decide if we want to take further action which could be orders or could be well, okay, you know, the generic letter approach didn't work; now we will go to rule making.

Okay, but at that point, we'd have to decide what further regulatory action we wanted to take -- what other tools we had available to us. Hopefully, the industry -- you know, by the time we get this package in final form and we've got their comments and everything, we'll all be of the same mind.

Therefore, hopefully, you know, we'll have agreement that everyone will, you know, when they get the generic letter, will make a commitment.

MEMBER SHACK: I guess I'm still confused because to me there are elements of this reg. guide which are really -- the performance criteria, at least as I understood it from yesterday, would be really part of an alternate repair criteria and would no longer be operative if you only chose to go with the compliance.

But the notion that you had to do condition monitoring and the operational assessment would be essentially mandatory. And so there are pieces of this that are compliance backfits and pieces that are optional,

and they're almost intermingled paragraph by paragraph at this point.

MR. STROSNIDER: This is Jack Strosnider from the staff.

I would add to what Brian said. Our current thinking and preliminary discussions is that a generic letter would include some sample technical specifications. And there will probably be two different sample technical specifications.

One would be here's what we think you need to do as a minimum to address those compliance based issues, and that would include things like qualification of NDE. It would include condition monitoring. And there would be some performance based -- some performance criteria in there.

So it would be a performance based tech spec. But there would be another set of technical specifications that say if you want to pursue, you know, alternate repair criteria, then here's the technical specifications that would fit that or at least some guidance, and that needs to be worked out.

But we do recognize, as you point out, that the regulatory guide has issues in it which we feel would be implemented through a compliance backfit and then other ones that would be optional, and we'd have to separate

those and make it clear in the letter which are which.

And that would probably be done through reference to the various sections of the regulatory guide.

MEMBER SHACK: And now when we say we're going to do the risk assessment a la 1061, the risk assessment we've talked about so far and focused on is the severe accident induced part of the risk. That is, you know, a piece of the risk.

Would you accept from the licensee him coming back and taking your structural performance criteria based on his risk analysis and proposing new performance criteria based on the risk -- or when you say risk analysis, do you mean just this piece of it after the core damage has occurred and the sort of thermally induced --

MR. STROSNIDER: Well, we're always -- I mean, the licensees can always come back and propose an alternate performance criteria. I mean, that's part of the process. They can do that if they want. What we're trying to do in the regulatory guide and with our interactions with the industry is come up with some performance criteria that we agree to.

We have made it clear --

MEMBER SHACK: So the risk analysis then would be confined strictly to this portion that we've been talking about, sort of 1570 kind of thing?

MR. STROSNIDER: I think that's the right answer. And one of the things -- and this gets into some philosophical discussions we've had before. If you look at the performance criteria, you know, they are intended, from our point of view, to address some of the other things in the regulations in terms of defense in depth and meeting general design criteria and those sort of things.

And we've had discussions with the industry and I think maybe even with this committee about some of those performance criteria and saying well, you know, perhaps some of those -- the probablistic criteria could be -- you could get higher probabilities of conditional failure, for example.

But at some point, we feel you're losing the defense in depth and the GDC philosophy when you do that. So, you know, our risk informed approach has been to show that the numbers are in there providing acceptable level of risk.

Going to prior failure probabilities as an example, although a risk based approach might say that's okay, you know, you end up putting all your eggs in one basket in some cases when you do that, and that's something we want to avoid.

So I think from a practical point of view, our real objective is to get some performance criteria that

the industry and the NRC agree to and that they would hopefully be fixed. People can always propose something different, but we would go through those considerations more than just risk analysis in deciding whether we thought they were appropriate.

DR. SHERON: One thing I just would add that -- you know, the Commission has told us in a recent SRM, and that is that when we move toward plant specific safety goals, which is really what Draft Guide 1061 does -- okay, it's an application of the safety goals on a plant specific basis.

And if you remember, the safety goals were really applied to a class of plants when they were first promulgated. And one of the things that I think both the Commission as well as the senior management in the agency has been concerned about is that when you do that, you don't want the industry to use the safety goals as speed limits.

Okay, in other words, if 10^{-4} is the core melt -- you know, you don't want -- a plant that has a 10^{-6} core melt, okay, to all of a sudden say well, I can do this, this, and this and as long as my core melt's still at 10^{-4} or less, I'm okay.

And that's what we're trying to prevent too, is we don't want the industry to go ahead and start making

wholesale changes just and use all this stuff as a speed limit. So we're trying to make sure that when they do use risk, okay, it's one piece of a number of considerations.

MR. STROSNIDER: Excuse me. This is Jack Strosnider.

Steve Long was just saying that, you know, I might want to go back and explain something to make sure I'm not misleading you.

The major contribution to risk from the studies that we've done is not just -- it's not coming from the thermally induced portion. In fact, when you look at that, that's just some percentage. And the risk assessment would have to address more than just that area. It would have to address the pressure induced failures and, you know, the --

MEMBER SHACK: No, but what I meant was this risk analysis starts with the core damage and marches onward. There's another risk analysis that goes back to the 0844 kind of argument that starts with the steam generator tube failure leading to core damage.

CHAIRMAN SEALE: Yes.

MR. STROSNIDER: Yeah, I think it's fair to say that the focus of this assessment is the large early release containment bypass. That's what you really want to be focused on. And you could build upon prior

evaluations certainly to get you to that point.

MR. LONG: This is Steve Long with the NRC staff.

Just to try to make this as clear as I can, when we looked at the risk for the study, we looked at all the pieces of the risk. There's an appendix in the 1570 that points out some of that, but there's a companion report that came from INEL that looked at the secondary depressurization induced core damage and release.

The risk that's going to come out of any sort of a change in the plugging criteria or the repair criteria is really going to be from the inability to precisely determine what it is that you have now in the way of a flaw and what that will be at the end of the next cycle.

So there's a lot of statistics that goes into trying to assess what you have and projecting it forward. What we've tried to do with the structural criteria is say that your target when you project this forward is that it will be able to withstand these challenges.

But the statistics will tell you that you may be wrong. And the probability of being wrong is what it really ends up being part of the risk equation. So that's what we're going to have to focus on in the description of how to take the structural criteria and come up with a

plan for showing that you have a high enough probability of succeeding at the end of your cycle.

MR. STROSNIDER: I think in fact a lot of that particular issue's already addressed in the regulatory guide with what we require in terms of NDE qualification to support an alternate repair criteria. As we've indicated previously, where you get into some additional risk here is where you start having a large distribution of deep flaws.

That's what would have to be assessed.

MEMBER POWERS: What do you do when someone comes in and says look, I want to have a little relief on my flaw distribution here, and I justify it based on the risk argument that goes somewhat like this. My probability of a spontaneous failure and temperature induced failure go up a little bit.

But, in contrast to what you've done in past risk assessments, I've taken credit for source term reduction on the secondary side of the steam generator. So in fact, my risk is -- calculated risk, you know, is just a little bit lower than what it was before I made any changes.

DR. SHERON: You're saying a licensee, you know, somehow finds a way to reduce the source term on the secondary side through, what, some pencil sharpening or --

MEMBER POWERS: Yeah, he sharpened his pencil.

DR. SHERON: And the like.

I think we'd have to look at it on a case by case basis. See what it really meant. I mean, it's hard to kind of prejudge how we would, you know --

MEMBER POWERS: Well, I've gotten the impression that you have in mind a criterion for the frequency of spontaneous rupture that you're going to find tolerable based on GDC-16 or whatever it is. And that up until it starts violating that sensibility, you will entertain things.

But once he starts violating that sensibility, then he's got a problem. You've got a defense in depth issue that comes to your mind. But you're going to try to quantify that sense?

DR. SHERON: I guess it depends if it could be quantified, you know, in any sort of a fashion that we could believe it.

MEMBER POWERS: I think -- I mean, for instance, --

DR. SHERON: -- flaw distribution and one of the biggest things I think we said is that the flaw distribution is a very elusive thing. And to say somebody can come in and say I want to change my flaw distribution and I understand it, okay -- I mean, the flaw distribution

is a dynamic thing. It changes with time.

You know, as the plant operates, it keeps changing and the like. So I'm not sure a licensee right now -- I won't say the word is smart enough, but actually has enough information to be able to accurately characterize the flaw distribution and be able to characterize the way it change with time such that, you know, they could say, you know, I want to go to a different one or something.

MEMBER POWERS: I can imagine a licensee coming in and saying look, the problem is the 40%. I can't tell whether this flaw that I've got an indication is 40%, but I can sure tell whether it's 60% or more. Okay, so what I'm going to say is that all my indications are less than 60% because I can do that fairly confidently.

And I'll fix anything that's more than 60%. And I've got a lot of information that says that they -- the flaws that are less than 60% won't exceed 60% in one cycle. They may in two, but not in one cycle. And it's a persuasive case.

And as a result of going to this -- letting me operate with these less than 60% flaws, I calculate that my spontaneous rupture frequency is now .04 per year. A little bit bigger than the 5×10^{-3}, but it's up.

MEMBER SHACK: It's a PRA cut a little bit.

MEMBER POWERS: That's right. It's a PRA cut a little bit because I'm going to come back and say but I have found that the source term coming to the outside has been reduced by two orders of magnitude when you look at decontamination on the secondary side.

So even though my spontaneous rupture frequency is up a little bit, my risk is in fact down by a factor of 20.

DR. SHERON: There's a lot of other parameters, I think, that need to be assessed in addition to just those. I mean, I would guess a licensee now would have to say what is my NDE capability; what is the likelihood that even though I'm telling you I'm taking stuff out of service if it's greater than 60%, what's the likelihood I would leave something in that's now greater than 60%?

And what's the probability that might grow to some unacceptable level to the point, and how does that affect risk?

MEMBER POWERS: But he's got a good story here.

MR. STROSNIDER: Let me --

MEMBER POWERS: Okay, I mean, all of those things are addressed. The operative question is he's

moved from 5 x 10^{-3}, 4 x 10^{-2}, and he's made a risk argument on the other side. And I made that jump big enough that it starts causing the hair on the back of defense in depth heads to get itchy anyway.

MR. STROSNIDER: Let me first comment that with regard to, say, for example, a deeper repair criteria, the framework that's laid out in the regulatory guide allows for that. Okay, given the information that you discussed, that could be implemented. And in fact, it could be implemented if a licensee chooses to go to a shorter operating cycle, which is an economic decision on the licensee's part.

They could plug at a deeper level and, you know, shut down more frequently. Those things are already allowed in the framework. But I think to try to respond to your broader question, say it as simply as I can, it is our intent to have -- to maintain defense in depth and to have criteria that we are comfortable will maintain primary coolant pressure boundary integrity.

That is in the GDC that we need to maintain that. We believe that's a very important thing to do. Right, and if a licensee comes in and wants to challenge that primary coolant system integrity based on some mitigating factors such as operator action or changes in dose calculations or other risk discussions, they're going

to have a hard time selling that to us, quite frankly.

That's what I believe is the case. Because the further you go out in that sort of analysis, the more and more uncertainties you're putting into it, and that's what we've seen. And that's the reason you need to maintain defense in depth. That's the reason you need to follow -- have some confidence that you're satisfying GDC in terms of low probability of primary coolant pressure boundary failure.

So that's our intent.

MEMBER KRESS: But you've already compromised the defense in depth. You've already done that. You've already compromised it. And Dana's just asking do you have criteria on how far --

MEMBER POWERS: I'm just arguing over price, Tom.

MEMBER KRESS: That's right, you're arguing over the price.

MR. STROSNIDER: The point he was making is if we establish some performance criteria, say a conditional probability of failure for steam generator tubes and someone comes in and says I'm an order of magnitude higher than your performance criteria but the -- you know, the release is going to be scrubbed in the steam generator; is that okay?

And the answer I'm giving you is I don't think it is. We need to maintain primary coolant pressure boundary at some level that we feel is consistent with the regulations.

DR. CATTON: What if they argue that it's with 95% assurance. In other words, you do a full uncertainty analysis and you go out on the edge and make the same statement.

MR. STROSNIDER: As we indicated before, we'll look on it a case by case basis. But you look at the analysis that's been done which doesn't even go past the release into this issue you're talking about and all the questions and uncertainties that can be raised, right. And I think it's a long way to get to where you're going to be comfortable in that providing the level of confidence that you want.

MEMBER POWERS: But let me come back and ask you again. Are you going to try to quantify this comfort level on the integrity of the reactor coolant system, or is it the situation, this 5×10^{-3} number is your quantification?

MR. STROSNIDER: The regulatory guide has quantified performance criteria in it now. And we're looking at some of the questions that have been raised on that, but that is our current thought.

MEMBER POWERS: And this is a canon. You're not going to give -- there's no relief available in this 5 x 10^{-3}?

DR. SHERON: Well, obviously, if it's not specified in the regulation in which someone has to request an exemption, then anything is fair game. Our feeling right now is no, we would not be willing to just willy-nilly grant relief to it because someone had, you know.

But we'd have to see the specifics of the argument. Okay, if somebody said I have a magic bullet -- if you let me increase this number, as a consequence, the risk -- you know, and the public health and safety goes down by ten orders of magnitude, we may say well, you know, maybe that's a good trade off. That's a good compromise.

Okay, but if somebody just says I've sharpened my pencil, okay, and therefore I want to take advantage of it, okay; the answer's probably no, all right?

CHAIRMAN SEALE: Steve had a -- I think he had something he wanted to throw into this.

MR. LONG: Dana, going back to your question which I think is really getting at defense in depth because you've asked a question about how to shave something thin with sort of a stone ax in PRA, it's not

very -- you can't do that.

(Laughter.)

CHAIRMAN SEALE: It's easier to thin it by mashing it than it is to shave it.

MR. LONG: But I think the way we've tried to approach this sort of thing is, rather than go all the way to the bottom line and say the consequences -- and you notice we already had trouble picking which consequence or how to weigh the various consequences -- we've tried to say we have -- we need some confidence in each piece of the PRA because we don't have a lot of confidence in the bottom line.

If we could look at the release from a steam generator tube rupture and come to the conclusion that it really was more in the nature of the kind of release you have when you have a core damage accident inside containment and have some sort of minor leakage through the containment, I think you could then start changing the criteria you use to accept the frequency of the core damage accident from steam generator tube rupture.

So, in that sense, there's sort of a change in watershed that you'd have to accomplish, I think, with the release calculation. Similarly, if you could in some way look at the frequency of release against the probability of mitigation. We do that all the time where you think

you're really trading off with some additional mitigation capabilities so you don't get the core damage.

But when I heard you ask your question, it sounded more like you were asking do we accept core damage accidents with a fairly high frequency if we were pretty confident nothing would get out of the containment. And I think there are lots of social reasons why we don't think that's a good idea.

So I really think the answer to your question is if we become confident that there is either some additional mechanism for scrubbing or that the scrubbing as it would naturally occur is really much better than we think it now is, that, you know, we could make that kind of change.

Otherwise, I don't think we can trade off the way you're suggesting.

MEMBER POWERS: What I'm trying to understand in reality is what the role of defense in depth is here.

MR. LONG: That's what I figured.

MEMBER POWERS: And I think there are two schools of thought. There are two schools of thought, by the way, on this committee. What we have called the structuralists who say I don't care about your PRA calculational capability.

Defense in depth is the safety structure and

it's there to handle all those things that you guys cannot handle very well in PRA and all the things you haven't thought about, and I'm going to not let you violate my safety structure which is defense in depth. And I'm going to say I want this containment boundary to be -- have a reliability, and I don't care what risk you calculate.

There are other that we would call the rationalists at their insistence. I had another name for them. It says oh, no, no; defense in depth is there to handle uncertainties in the PRA. And if the uncertainties get too big, that's when we impose defense in depth. It's to keep the uncertainties from getting out of hand.

And I think all we've heard here is that indeed this -- that Brian certainly has what I would call a structuralist point of view on defense in depth and wants to maintain the allegiance to Appendix A. And I think that's fine. I think you need to be firm in your beliefs on this because you're going to run into questions from the rationalists.

DR. SHERON: If there's enough information that's presented across the boards, let's say, that says that 5 x 10^{-3} number should be changed, okay, fine. I mean, it's in the reg. guide. Okay, it can be changed. Okay, but we'll do it in a structured fashion and we'll do it in an open public forum with appropriate debate and so

forth.

We'll be down here again telling you we want to change that number. Okay, and if we do change it, it will be done on a collective basis. It's not going to be done by the staff on a, you know --

MEMBER POWERS: On a case by case example.

DR. SHERON: Where you were sitting at their desks deciding whether they're going to do it. The answer is going to be this is the number, this is what we expect you to meet. The industry wants to present a basis that says we should change that number because it's not the right number, then we're willing to listen and we'll do it in a structured open forum.

Does that --

MEMBER POWERS: I think that's what I wanted to hear.

DR. SHERON: Okay.

CHAIRMAN SEALE: I think we've beaten this horse pretty well. I want to make two comments, and then --

MEMBER POWERS: You're going to get to beat this horse for years.

CHAIRMAN SEALE: I know. I just want to make two comments and then I'm going to call a 15 minute recess.

First comment is that in the case that you listed, that 10^{-2} or whatever that number was you gave for the scrubbing in the secondary was always there. It's not something that you did procedurally or anything else to get it. And an element of defense in depth has always been the conservatism in some of the assessments or some of the things that we analyzed.

The other comment is more a matter of personal privilege. When I started in my technical career, there were still arguments about the systems of units that were to be used in various things. And I always thought that one of the most devastating public relations or selling jobs that was ever done was by the group of professors at MIT who decided that their set of electromagnetic units would be called the rational set; implying, of course, that everyone else was irrational.

So your categorization has been given its due worth.

So we'll come back at 10:15.

(Whereupon, the foregoing matter went off the record at 10:05 a.m. and went back on the record at 10:25 a.m.)

MEMBER FONTANA: Where are we at, Mr. Chairman?

CHAIRMAN SEALE: I thought we would try to run

on down -- well, maybe I should suggest a course of action and if we agree with that, we can work from there.

The staff has indicated that they are presenting a -- or they are preparing a Commission paper that will submit to the Commission their proposed approach for resolving all of these issues and they will be in a position to present that paper to us at the April meeting with the intent of or with the hope then that we would be able to write a letter on that subject for the Commission to consider at that time.

MEMBER FONTANA: A letter at the April meeting?

CHAIRMAN SEALE: At the April meeting on the Commission paper that the staff is preparing.

MEMBER FONTANA: That means another meeting before April?

CHAIRMAN SEALE: No. We would have a presentation on the Commission paper at the April meeting.

MEMBER KRESS: Then write the paper in the May meeting?

CHAIRMAN SEALE: Yes.

MEMBER FONTANA: Oh, write the letter in the May meeting?

CHAIRMAN SEALE: No, we can write the letter

in the -- if we get it two weeks before.

MEMBER KRESS: If we get it two weeks before we hear the presentation.

CHAIRMAN SEALE: Yes, yes.

MEMBER KRESS: And the presentation will be at the May --

CHAIRMAN SEALE: Yes, at the April meeting.

MEMBER KRESS: May meeting?

CHAIRMAN SEALE: April meeting.

MEMBER POWERS: Bob wants the presentation and the letter to be done in the same month.

CHAIRMAN SEALE: Yes.

MEMBER POWERS: And presumably that's because the letter --

CHAIRMAN SEALE: Is largely --

MEMBER POWERS: We at least know what the outline is going to be.

CHAIRMAN SEALE: Yes.

MEMBER POWERS: And presumably it would go to the Commission shortly after our April meeting?

CHAIRMAN SEALE: Yes. So it's available to them at the time when they're considering the proposal from the staff.

MEMBER POWERS: And if we want to have additional discussion on it, we have enough information

now on what this outline is going to look like to discuss it at least in a philosophical sense.

CHAIRMAN SEALE: During the March meeting. No, we don't have any time -- well, we have letter writing time, yes.

The other thing we could do is to ask the staff to give us a presentation on the Commission paper on the day before there's going to be another thermal hydraulics meeting on a whole bunch of generic letters that we're talking about which is -- what is that, the 28th?

There's a meeting scheduled on the 28th of March and we could ask you to make a presentation on the 27th on the Commission paper. Now that's just a week before the April meeting, because the April meeting is the Thursday and Friday of the following week.

MEMBER POWERS: Are we going to have any significant comments to make on this approach?

I mean is this going to be a letter that says looks good to us.

CHAIRMAN SEALE: Well, it's hard to judge what the Committee is going to decide.

MEMBER POWERS: I'm asking you to define the oracle here and --

CHAIRMAN SEALE: That's an impossible chore.

I feel that there are so many issues that -- let's say there is a decision on so many issues that is implicit in this position, the staff recommendation to the Commissioners that we're likely to have some things we want to say.

MEMBER POWERS: But it seems to me the Commission paper is simply going to outline an approach.

CHAIRMAN SEALE: Yes.

MEMBER POWERS: That the implementation of that approach comes to us again.

CHAIRMAN SEALE: Yes, it does.

MEMBER POWERS: And it is -- it strikes me that it is more likely in the details of the implementation that we would have comments than the overall philosophy. Because it seems to me the overall philosophy has been dictated for them by 50.109.

MEMBER SHACK: But the Commission paper will, for example, suggest sending this stuff out for public comment.

CHAIRMAN SEALE: Oh yes.

MEMBER SHACK: So is this ready for prime time here.

MEMBER POWERS: Yes.

MR. SHERON: Well, no actually, the Commission paper we were following the path of rulemaking, okay and

we had explained that there were certain pieces all associated with the rulemaking. There's a statement of considerations, but a lot of the stuff is the same. There's still the reg. guide. There is still, I think there is a generic letter we were talking about for also to implement the tech. specs and the like and there's still the report which addresses the DPO concerns. And that's all still on-going and doesn't change.

The only thing the Commission paper and again, I'm prefacing this, I'm assuming that the management reaches agreement on it. We haven't really briefed them on it, but under the assumption that they agree with it, then the Commission paper would basically go through what you've heard today and it would say we've done the risk assessment. We've done the regulatory analysis and as Dana said, based on the conclusion then, the fact that we can't really justify any cost enhanced backfits or anything, our feeling is that we can implement a regulatory framework or a regulatory approach for dealing with steam generators within the current regulatory framework that does not necessarily involve a rule.

See, the Commission right now thinks that we're going forward and we're going to present them a rule and what we're saying now is that it looks like we don't really need to have a rule to do what we want to do.

MEMBER SHACK: Okay, but when are you proposing to send this stuff out for public comment, presumably not -- that will be -- there's the generic letter, the whole bit.

That's still months away then, right?

MR. SHERON: The original schedule was to send a package in May to the Commission with the proposed rule. So we're following 1061 so that's on its own schedule. We've got to look right now and see what we would support, but I would not think that we're going to have anything ready to go out for public comment before May.

MEMBER SHACK: So it will be really on this approach then, rather than anything else?

MR. SHERON: Yes, and if there's anything else that is still that you think is problematical or anything, obviously that's up to you whether you want to tell the Commissioner if you think we're doing a great job. You're always welcome to tell the Commission.

But we would really like as a letter in terms of whether or not I think the Committee either agrees or disagrees with this revised approach, based on what you've heard here today.

We are willing to come down, obviously, on the 27th, if you need more information. I would hope that the Commission paper would be out by that time.

MEMBER POWERS: It seems to me more likely that we would like to look at the package that goes out for public comment than -- as a subcommittee --

CHAIRMAN SEALE: Than look at the Commission paper.

MEMBER POWERS: Than the Commission paper. I think that's -- I think we've seen all they have to offer.

MR. SHERON: You won't hear anything different, if they come down on the 28th and present to you what's in the Commission paper. You won't hear anything different than what you heard today.

MEMBER POWERS: I'm sure that the Commission paper will be a little more structured and certainly less interrupted than the presentations here, but I don't anticipate anything different.

I think that in thinking about the package that goes out for public comment that we do have to confront this detail question that seems to come up in these things all the time, too much or not enough. And my feeling is that the current approach that they're adopting is one that better justifies the level of detail in the existing reg. guide than more risk-based, risk-informed -- God help me if I've said the wrong word here, risk-informed approach did. I mean it becomes much more understandable now.

CHAIRMAN SEALE: Yes.

MR. SHERON: I think if there's any other areas that we need to discuss more, for example, the section we would add to the reg. guide with regard to considerations a licensee would need to take in looking at risk. If they would relax a criteria. I think we owe you a presentation on that once we write up the section. That might be something towards the end of April, the subcommittee meeting might be an appropriate time to go through that.

And if there's any other areas again from your list that you feel you need more information on we can also either do it on the 28th, March 28th, if that's a convenient time or else we would have just a larger meeting maybe some time in April.

MEMBER POWERS: It looks to me like, if I had a vote that I'd say that any additional subcommittee meeting comes in April and even that's contingent upon on some examination of the material.

CHAIRMAN SEALE: Of the material, yes. I just don't anticipate anything dramatically different than what we've seen. This is not even a complete cross section of the ACRS, let alone the complete ACRS.

We do have people with different interests and views, but if I had to bet, I'd bet that that would be the

efficient use of our time and efficient use of staff resources as well, because it's not easy for them to come in and do the marathon presentations.

Well, that sort of complies with what I had in mind, that we would expect to get a presentation of appropriate length, hour, hour and a half, something like that on the Commission letter and we would write a probably fairly short letter endorsing and or taking perhaps some exception, but not probably much we can think of now.

MEMBER POWERS: I think it's more likely that we would offer caveats.

CHAIRMAN SEALE: Yes, comments. And then when the paper, when the full package is available for public comment, we'd like a chance to look at it and ask for a presentation on certain parts of it or perhaps all of it at that time. So that's kind of the way I think we ought to go from here and I suggest that to the subcommittee

MEMBER POWERS: I would suggest in this more complete presentation on the final package that thought be given to walking through the reg. guide with an idea toward communicating why the elements are there from a necessary and sufficient to insure quality point of view.

This has been area that you get this very nebulous criticism. There's too much detail and not much

help on what's the appropriate level of detail and I think you must need to confront that. And say there's something that bothering people and they don't understand why it is necessary and sufficient to have each of these sections in the reg. guide, less so on the technical justification, but more on the necessary and sufficient kind of viewpoint.

CHAIRMAN SEALE: Uh-huh.

MEMBER POWERS: Because it looks, when I read it I think you've had a necessary and sufficient kind of viewpoint. Here are the things we think it's necessary for the licensee to do and if he does it, this is sufficient to satisfy our need and if you can communicate then when you describe this and I think you get rid of this nebulous criticism.

CHAIRMAN SEALE: And it would be, in a sense, be the kind of thing that -- the kind of evaluation that the licensee would have to do in making the decision as to whether or not they wanted to invoke this process.

MEMBER POWERS: I think so.

CHAIRMAN SEALE: In the skeleton form, not the detail, but just okay, I need this and this is why ad this is the kid of detail I would have to get into in order to satisfy that requirement and build that structure to make a decision as to whether or not it was worth the honor, so

to speak.

Okay, well, I think that kind of puts us in perspective. I would suggest -- I'm sorry, I would suggest that we ask the people from industry if they would like to make a few comments. I understand they've expressed an interest in doing so.

MR. MULLINS: Yes sir. I'm Rick Mullins from Southern Nuclear Operating Company, a member of the NEI task force on the steam generator rule. And I had a few brief comments that I wanted to make.

The first comment is realize that the industry has not had the benefit of seeing the risk analysis, not had the benefit of seeing the regulatory analysis. We haven't had the benefit of seeing the draft guide 1061, so the first time that we have heard any of these concepts and approaches was yesterday.

Consequently, we don't expect a whole lot of detail comments today and we would ask that those documents be provided to the industry so that we can review them and have adequate time to look at these approaches and develop a better understanding of the tack that's trying to be taken.

With that said, a couple of comments on the regulatory analysis. It was characterized yesterday as I guess two parts, one is a compliance backfit and one that

has to do with alternate repair criteria,only to point out that there are significant requirements in this draft regulatory guide which the industry is not following today, has never followed, that we have difficulty in accepting as a compliance backfit.

A couple of points in case, NDE requirements for inspection techniques not associated with risk of severe accidents. The requirements in the reg. guide greatly exceed anything that the industry is doing today. To characterize that as a compliance backfit, I guess is a stretch in my opinion.

Along the same lines, performance criteria. The industry and the staff have not agreed on any of the performance criteria, but yet we'
re having to meet those performance criteria and to say that we have to meet these new performance criteria in order to comply with regulations again seems to be a stretch from where we are today.

Discussion that was held this morning was that the operational assessment conditioning monitoring would be required from an industry standpoint, but the performance criteria are optional. We've been doing operational assessments and conditional monitoring at Farley longer than anybody i the industry and I have difficult in understanding how you can separate those

concepts.

How do you do an assessment without having a criteria to meet?

Again, on the risk analysis, again yesterday was the first day we had seen a lot of that. We do not understand some of the conclusions that were reached. We had asked that those analyses be provided to the industry so that we can review those analyses and compare them to the ones that have been performed by EPRI.

MEMBER POWERS: Could you tell us what conclusions you have troubles with?

MR. MULLINS: There were specific PRA numbers which came up that I guess the difference in implementing the rule as it was proposed was like .7 to 10 to the minus 6 and yet we're going to require detailed risk analysis for the utility which wanted to implement something that would cause that change, doesn't seem consistent with parts of that analysis.

That's just one comment. Thank you.

CHAIRMAN SEALE: Very good, thank you very much for sharing your reactions to this. We appreciate that you haven't had the opportunity to really look over this material in detail and certainly after you've had a chance to do so we look forward to hearing from you again.

MEMBER POWERS: And in fairness to ourselves

and all concerned, today's meeting and yesterday's meeting were focused much on the parts of the rule that were not the compliance backfit, compliance issues.

CHAIRMAN SEALE: So in thinking about a presentation for prior to going out for comment, I think we have to address why things are compliance and not a backfit.

MEMBER POWERS: Okay. Thinking of this necessary and sufficient arguments for the reg. guide and the generic letter, you need to think about why it's - and articulate why it's a compliance issue and not a backfit issue.

CHAIRMAN SEALE: How do you justify this?

MEMBER POWERS: It really wasn't the subject here, but I mean it's a legitimate concern.

CHAIRMAN SEALE: Very definitely.

Well are there any other comments. Mr. Hopenfield is supposed to be here at 11. We called him about 11. Perhaps we should go back to our list then of concerns and we can elaborate on those further.

There was the incomplete -- one of the topical areas was incomplete and sometimes perfunctory analyses required to provide an assessment of relative risk. I think you addressed that pretty well in the presentation you made. If you hit any ball, that was it.

So that -- I think we're in better shape.

MEMBER POWERS: In a strict definition, the incompleteness may still exist, but perfunctory went out the window.

CHAIRMAN SEALE: Yes, that's right. Reliance on core damage frequency alone is an indicator of risk. Well, that' snot true any more. You have looked at the LERF as a

-- in making the assessments in your value, whatever that VI, assessment.

We talked quite a bit about defense-in-depth and I think we understand each other a little bit there, a little bit better there based on the discussion that Dana stimulated earlier.

And then we have our recommendations and those are largely imbedded back in the concerns.

MEMBER POWERS: In our previous meeting there were a set of what I recall nitty-gritty type issues where there was dissension between the staff and industry. they were very specific sorts of things, factor of 3 safety factors versus 2.7 and some discussion on leakage rate and things like that. Have those been resolved?

MR. STROSNIDER: This is Jack Strosnider from the staff. As I indicated earlier, no, they have not been completely resolved. Since that last meeting at least

with regard to the deterministic factors of safety, the factor of safety 3 and 1.4 that you mentioned, we did receive an analysis of evaluation of that from the industry and we're currently reviewing that. We're having some independent review done of that, to try to get some objective view of those criteria.

It's not been resolved yet, but we recognize we need to come to some conclusion on that and we would plan on doing that as we proceed through this process, hopefully, we could have something before this goes out for public comment, but certainly if not, we would treat the paper that we got as part of the public comments and resolve --

MEMBER POWERS: Oh, okay, so it counts in the public comments and if you haven't resolved by the time you go out --

MR. STROSNIDER: Oh, certainly and it would be. Before it's vitalized. It obviously has to be resolved.

MEMBER POWERS: Remind me again what the leakage controversy was.

MEMBER SHACK: Whether it indicated failure of the program.

MEMBER POWERS: At, that's right that's right. Yeah, whether it indicates as Dr. Shack indicated, a

failure of the program.

Basically, should it be -- currently, the technical specifications have a limit on primary, secondary leakage which, if exceeded, drive the licensee to perform additional inspections. We're proposing a performance criteria of a similar leakage value which if exceeded, it would indicate that you need to go back and reassess your program and see if any corrective actions were necessary and there's some question about the legitimacy of that as a performance indicator.

MEMBER POWERS: Yes, it was more whether there should be injected in there an assessment step where immediately moved to that.

CHAIRMAN SEALE: Yes

MR. STROSNIDER: I think that's the case, yes.

MEMBER POWERS: That seems like an easy one to resolve.

CHAIRMAN SEALE: The questioning of the basis of the .05 tube failure per year criteria, I guess you've discussed that somewhat.

MR. STROSNIDER: It's a fairly straight forward response, I think. Whether you accept it or not is a different question. Basically, if you go back to the prior risk assessments that have been performed, specifically NUREG 0844, the assumption in there was that

there was a .05 conditional probability of failure and that resulted in an acceptable level of risk. So from our risk-informed perspective, it provides an acceptable level of risk. Now the staff also looked at it and there's been discussion with the industry about perhaps that number could be even higher. We've looked at it and said no, we don't want to see it higher than that based on our arguments of defense-in-depth and satisfying GDC and other considerations in the regulations.

So we think it's an appropriate value based on those arguments. I would also point out that the risk assessment that's been performed most recently when they went back and looked at these pressure induced failures, again, concluded that that was an acceptable conditional failure probability.

So that's where the conditional probability main seam line break comes from. The performance criteria for spontaneous ruptures, there were numbers for that assumed also in 0844. This is actually a little bit lower number which is based on current operating experience and it's basically saying let's keep things consistent.

MEMBER SHACK: It's like a little bit lower.

MR. STROSNIDER: Yes. but it's basically saying let's strive for performance criteria to maintain something that is consistent with what we're seeing today.

CHAIRMAN SEALE: What about the multiple tube failure problem where single tube induced failures?

MR. STROSNIDER: That's an interesting point because there are, as you're pointing out some numbers from probability conditional failure probabilities of multiple tubes. Some of the recent work that was done is indicating that perhaps those numbers may not be necessary or they may not be necessary to be the numbers that are there. I think it's based on some of the thermal hydraulic analyses and work that's been done, so we need to take a look at that also.

CHAIRMAN SEALE: It's interesting to me, there are two cases now where we have the blessing and the utility has the difficulty of common design and that Duke is now replacing the steam generators at Catawba and McGuire and then you mentioned that we have the Braidwood, Byran set. That's statistically enough tubes between in each case and are they similar systems?

MR. STROSNIDER: Yes.

CHAIRMAN SEALE: So there's really four plants there with essentially the same steam generator basically. So that you should begin to be able to get some pretty good statistical information and I would think that the question of whether or not the failure mechanisms in the different plants are really that similar or whether

they're different difficulties depending on whatever, you know. Are the Catawbas similar to the Byrons, for example?

MR. STROSNIDER: There are certainly trends with regard to vendor and model numbers or designs of steam generators. If you look at the design features such as the type of roll at the top of the tube sheet. We know pretty much based on the data that are out there what sort of degradation to expect at that location.

CHAIRMAN SEALE: Yes.

MR. STROSNIDER: So it's true that you anticipate to some extent what type of degradation, at least you know what's happened in the past.

The difficult part of it is that the time at which this degradation might show up and the rate at which it increases is different from plant to plant and that gets into some very plant-specific situations as regards water chemistry and maybe the heat of the material that was in the tubing. And as I mentioned yesterday, even between generators in a plant, you can see differences in the time or rate at which degradation shows up.

We do look at that and I think some of the staff has a pretty good handle.

CHAIRMAN SEALE: It might be interesting, entirely aside from this discussion to find out what AEOD

plans to do in by way of assessing that information or whoever does that kind of assessment to look at those sets of data now because they do give you statistics presumably there's some statistics there we've been wanting to get.

MR. STROSNIDER: And materials and chemical engineering branch in NRR, my branch, basically does most of that. AEOD is putting out a report, I think. I don't know if it's out yet. A NUREG report, summarizing some of the steam generator operating experience.

One thing I would mention in this regard is that we are in the process of putting together a data base of steam generator operating experience that includes design features, different, what types of degradation are seen in different generators and at what locations in the generator, in order to help us look at this kid of trending.

CHAIRMAN SEALE: When you're ready to talk about that, I'm sure we would be very interested to hear what your plans are and what you expect to get out of that.

MR STROSNIDER: I should also mention that the industry maintains a data base and we're trying to make them complementary.

MEMBER POWERS: Is there somebody in this world that looks at a better material?

MR. STROSNIDER: Well, and of course, if you look at the replacement steam generators, particularly those -- they've gone to Inconel 690, higher chromium content, better corrosion resistance and even some of the 600 thermally treated materials, if you look at the replacement generators which go now back to the early '80s, there's been much better operating experience, partly due to materials, partly due to design changes and support plates and fabrication methods and also due to water chemistry control.

So the good news of this is that the replacement generators do up to this point seem to be operating much better than what we've sen in the past.

MEMBER POWERS: It just strikes you that there's mileage to be made in a little corrosion research here. but I'm reminded as my corrosion friends point out to me that the national expenditures on corrosion and corrosion failures is in the multiple billions of dollars every year.

MEMBER SHACK: Ziebart them.

(Laughter.)

CHAIRMAN SEALE: I recommend you maybe do a reassessment on the quality of the advice you're getting.

(Laughter.)

MEMBER SHACK: Do you continue to disagree

about the 20 percent allocation to each mechanism?

MR. STROSNIDER: No, we need to assess that. The issue here is performance criteria of 5 times 10 to the minus second and what's in the regulatory guide is that it indicates that no one vote of degradation should account for more than 20 percent of that.

That really came frankly from the approach we took in generic letter 95-05 in which the acceptance criteria in that letter is 10 to the minus fifth. It was purely judgment that well, we know there's other degradation mechanisms going on so we don't want to eat up all that additional probability with this one mode of degradation. Maybe there's five, four or five modes of degradation going on in a generator.

It obviously has some drawbacks to it. It's a very judgmental --

MEMBER SHACK: It would make more sense in that context because you were considering all of the degradation mechanisms.

MR. STROSNIDER: Right.

MEMBER SHACK: But in this context where you are presumably considering everything, then it's total performance, it seems like.

MR. STROSNIDER: Right, and the other comment that the industry has made and that we're looking at is

that there's other approaches to this which would be, for example, that the total probability should be five times 10 to the minus second. When you sum it over all the active degradation modes.

The one thing that we're trying to come to grips with there is the modes of degradation that you don't know about that show up during the cycle. And so again -- and then we look at it and say well, you know, do we say it's 20 percent for the mode of degradation we don't know about so we end up with a performance criteria that's four times 10 to the minus second instead of five? It's kind of splitting hairs.

But we recognize the point that's been made and we're -- we've been having discussions and trying to look t what's the most rational approach. The overall, the objective, I agree though is that the overall probability should be 5 times 10 to the minus second and how you allocate it is something that we need to probably take a harder look at based on the comments we receive.

CHAIRMAN SEALE: That's always an interesting rule. Sophistry you get into when you start allocating from that direction. You have to go find another mechanism in order to be able to give out the list.

MR. STROSNIDER: Right.

CHAIRMAN SEALE: Any other of the concerns

that anyone would like to reemphasize as being active? Mr. Hopenfield is supposed to be here momentarily. I hate to hold everybody in abeyance.

Would you tell us what you plan to do with this? You are preparing a separate report specifically addressing the difference in professional opinion?

MR. SHERON: Yes, there's I believe two letters, Dr. Hopenfield has submitted to the EDO.

CHAIRMAN SEALE: There's also a letter we prepared, I think.

MR. SHERON: Right, and the EDO has responded to Dr. Hopenfeld, explaining that the staff would be addressing these as part of the rulemaking package.

We are preparing a separate report. It will address each one of the issues that Dr. Hopenfeld raised. I'm not claiming that its going to satisfy him, but th staff is assessing the concern, looking at it from the safety significance and the like and whether or not we've dispositioned it properly as part of the rule making. And that report, I don't know if we have a schedule, Tim, but we would make it available to the Committee, as well as Dr. Hopenfield when we finish it.

CHAIRMAN SEALE: But you are attempting to respond to all the questions that were on his --

MR. SHERON: Yes sir.

CHAIRMAN SEALE: Well, does anyone want to play music or something?

(Laughter.)

MEMBER POWERS: Let's exercise our legs a little bit.

CHAIRMAN SEALE: Well, we'll stand by for --

MEMBER FONTANA: For an entrance.

CHAIRMAN SEALE: For an entrance.

(Off the record.)

CHAIRMAN SEALE: I believe we've got --

MR. HOPENFIELD: I thought I was scheduled for 11:30. I'm sorry.

CHAIRMAN SEALE: No, no, it was, but we managed to converge or to agree to disagree or whatever it is we did quicker than we had thought, so we appreciate your accommodating us.

MR. HOPENFIELD: I appreciate you giving me the time.

CHAIRMAN SEALE: Certainly.

MR. HOPENFIELD: And as a matter of fact, the reason I'm here I'd like to point out to you that there is a thermal hydraulic analysis that is invalid and --

(Microphone is being adjusted.)

MR. HOPENFIELD: I don't think you would need him, we already talked about this last time. I run

through a little bit more details in this packet.

CHAIRMAN SEALE: We need him because we feel insecure otherwise.

MR. HOPENFIELD: You're welcome to throw all the darts you have at me.

CHAIRMAN SEALE: Just one moment, we have asked the staff what the status is on this and they've indicated that they have two letters that you have written and they are preparing a report which responds to all of the questions that are in your two letters and also to a letter that we have written to them requesting that information.

So they are in the process of putting together a report that they believe is responsive to your concerns.

MR. HOPENFIELD: Okay.

CHAIRMAN SEALE: With that comment, we'd like to hear what you have to say.

MR. HOPENFIELD: Okay. I don't know which letters you're referring to. No, that's okay. We'll see when they come up.

CHAIRMAN SEALE: Okay.

MR. HOPENFIELD: Again, the reason I'm here is to discuss, make a few comments regarding the thermal hydraulic analysis in that NUREG, because the conclusions strongly depend on it.

Four years ago, five years ago, as part of the DPO, I made a very quick analysis and concluded that the surge line will fail after the tubes fail because of the degraded tubes. Five years later, four years later, the NUREG report indicates that that's not the case, that in most cases the steam generator tubes will fail after the surge line.

What the implication to the severe accident -- and that's the bottom line, that's what you're interested in, I wasn't given the opportunity to take this further, so any questions you may have regarding the containment bypass frequency you may address to Mr. Boslik. I asked him because I'm not familiar with the risk analysis or with these numbers.

The reason for the differences and that's really what I'd like to talk about is the -- in the NUREG analysis there is a mixing in the inlet plenum and the analysis that I have made I ignored any mixing and I assumed the steam comes out of the hot leg, just hits the tubes as it is. And that is the basis, that's not the only one, but it's the major basis for the differences between the results.

As you look at a steam generator, partial cut of it, I think it's the Model F, you look at the plenum, the inlet plenum, you have various streams. Is there a

pointer that I could use?

(Pause.)

You have a counter flow in hot leg and then you have a plume that will be rising because of buoyancy effect. On top of it you also have first convection flow due to the leakage of the tube. You have thousands and thousands of cracks of unknown dimensions and size. There's a finite probability that some of those will leak. The basic assumption here there's one crack that's going to leak. That's the reason for the stream that you have on the right hand side of the top.

The other streams that you have are the normal streams that you have mixing in a room where you have walls that are at different temperature than the major of the bulk of the fluid. So when you look at this kind of configuration you want to model it, but the first thing what you do you see what is governing it. Well, how do you look at that? You start comparing values. You compare different intensities of the flow. Well, if you do that, you find that the leaking tube is on the order of 10 to 250 pounds and - which I will discuss in a little more detail in a minute -- and the conduit flows on the order of 4 pounds. So you've got this huge flow going through there. It doesn't know that -- or how you know that there's four pounds of convection in there.

Now what was done in the NUREG report was to assume that this flow is insignificant compared to the counter flow. Now the reason it neglected it is because the whole analysis in this SCDAP or RELAP analysis is based on the mixing of the 1/7th scale model that was conducted some time at Westinghouse. Now the basic difference here is that that model didn't have any leaking tubes. Now there are other differences, the question about deposits which will affect the flow distribution, but I just focus on one and that is the first convection flow that you have when you have 2500 pounds difference between the pinhole somewhere in the tube and you're in an inlet plenum.

So if you look at the mixing process in this kind of configuration, the mixing is going to be drastically different when you had this flow here which not only affects the flow here, it also affects the heat transfer on the secondary side. So the entire pattern of mixing, it's just not applicable. The whole question of mixing in plenums and rooms, anybody who has done any firing modeling would know this is an art. It's hundred percent art.

MEMBER KRESS: Could you give me some idea of what sort of analysis you went through to arrive at this 10 to 250 pounds were second?

MR. HOPENFIELD: That's my next slide.

MEMBER KRESS: Okay, I'm sorry.

MR. HOPENFIELD: So you have a situation where you cannot take this data that was generated at Westinghouse and say I'm just going to perturb the thing and run some sensitivity studies because you're running sensitivity studies on an entire different model.

There were the certain mixing ratio that was relevant for these particular tests. It's completely irrelevant to what you're going to have here.

Now --

MEMBER SHACK: Your second bullet really should be where there was no leakage?

MR. HOPENFIELD: Well, I thought I said that.

MEMBER SHACK: You did state --

MR. HOPENFIELD: We're at analysis based on 1/7th scale test where there was no mixing.

MEMBER SHACK: You mean no leakage, don't you?

MR. HOPENFIELD: No leakage, I'm sorry.

MEMBER SHACK: Thank you very much.

MR. HOPENFIELD: You are right. I apologize. Okay, I'm going to give you plenty of opportunity to take shots at me.

Let's take a look at what happened when you have a pin hole and I picked up the .001 through the wall

crack. Anybody that has some experience with cutting with torches or working with torches, you realize that you have the center of the jet, you have a high intensity region and that as you go away the air is being -- the jet entrains the air from the outside and you have a spread of the jet besides the expansion of the jet itself.

Now the problem gets a little bit complicated because in addition -- it's not a pure jet that you have. You have a lot of particles that are really like sand particles that really cut through the material. So what you really have you have a region, if you look at a thing across the jet, you have a region of different intensities. In the center you'll cut through faster and as you go away, you'll be less severe.

So it really amounts to what kind of material you're talking about. A soft material would probably have a larger spread. A harder material would be narrower and obviously it also depends on the distance from the work place, upon the work piece, so to speak.

Now there is no data in the literature on this kind of project that you have, that you're going to have in the case --

MR. CATTON: What kind of jet is this? I mean you have a .001 inch hole. You have a pressure ratio that's what, about 2,000?

MR. HOPENFIELD: Correct.

MR. CATTON: There's information on this kind of a jet.

MR. HOPENFIELD: Steam. Yes, there is.

MR. CATTON: What is it that I don't have information on?

MR. HOPENFIELD: Okay, what you don't have information is how fast you're going to be eroding the material, how it's going to be spreading --

MR. CATTON: Slow down. Are you talking about eroding the size of the hole?

MR. HOPENFIELD: Eroding both, the size of the hole and the --

MR. CATTON: Where it impinges?

MR. HOPENFIELD: And where it impinges, both. Let me answer your question.

MR. CATTON: There is data on this sort of thing.

MR. HOPENFIELD: There is millions of data, but there is nothing under this kind of condition that we're talking about. The closest one -- you see, the important thing is the material. And the material we have here is Inconel 600 and I believe that the people --

MR. CATTON: The sand or whatever it is you were talking about, what it is, its size distribution and

number density are also important.

MR. HOPENFIELD: That's right. That's what I'm saying. In this particular sense it's probably aluminum oxide of whatever, boron oxide, whatever you have.

MR. CATTON: Aluminum oxide can erode pretty well.

MR. HOPENFIELD: Yes, whatever you have in the system. I don't know. You definitely have boron oxide. What I'm saying there is no specific data on how all these parameters come together and affect, tell you what is going to be the exact spread of the jet as a faction of the distance between the tubes.

MR. CATTON: That we know.

MR. HOPENFIELD: That's what I'm saying.

MR. CATTON: What you can't calculate is the erosion rate at the second tube.

MR. HOPENFIELD: I cannot or can?

MR. CATTON: You can. I'm sorry, you -- I don't know if you can calculate the erosion rate of the second tube. You certainly can calculate the characteristics of the jet.

MR. HOPENFIELD: Okay.

MR. CATTON: Including the barrel shocks and everything.

MR. HOPENFIELD: Okay, the erosion of the second tube was calculated by NRR. They came up using analogy with superheated tubes on some program. They came up with number -- with time scale from like 5 seconds to about 40 seconds which I think is reasonable.

Now the question is how fast this thing is going to propagate. You have to realize you have 9,000 seconds here that you have sitting there before the surge line goes. So there's plenty of time there for the accident to propagate. So if you look at 9,000 seconds and you say okay, what does it take to erode, well, I use their numbers, average number what they suggested.

I have calculated my own number some times before and they were much faster. The reason they're faster, you see ,it's not only just -- you already have degraded material. You don't have a 40 mil wall with a brand new material. It's not there. It's a degraded material that you start with. The data they use came from some superheater and they do not report the spacing between the superheater. It's usually about an inch.

So using their erosion rates, using a 30 second kind of thing, the question is how is it going to propagate? Well, the way it's going to propagate is how fast it's going to drill through the next one, next one, next one, next one. And as it goes and drills through all

these, now each time the jet goes it expands. That question is how much expand, I don't know exactly how much it expands. That's really what the issue is here.

But I assume --

MR. CATTON: The hole size, you're assuming, is .001 inch?

MR. HOPENFIELD: Correct.

MR. CATTON: And the spacing between the surfaces of the tubes is?

MR. HOPENFIELD: The spacing is what you have on the model. It's about one inch.

MR. CATTON: Surface to surface, half inch?

MR. HOPENFIELD: This -- well, it's less. It's about 300 mils. Take a look. You've got an inch between --it's about an inch and the diameter is about 11/16ths so the tube is about 300 mils.

MR. CATTON: .3 inches?

MR. HOPENFIELD: Something like that.

MR. CATTON: So what you're talking about is 30 diameters, 30 hole diameters away?

MR. HOPENFIELD: Right.

MR. CATTON: Your hole is .001.

MR. HOPENFIELD: Right.

MR. CATTON: The distance is .3?

MR. HOPENFIELD: Right.

MR. CATTON: 300 diameters.

MR. HOPENFIELD: Later on we'll see it's not that critical. Let me finish --

MR. CATTON: That's one of the key parameters.

MR. HOPENFIELD: Well, usually what it takes, okay, it is a key parameter, but there's no data about the core and the spread for this particular jet, but if you look at liquids, okay, high velocity. L over D with nothing -- turbulent flow. Over there you get into the Weber number because that's you tear the particles.

But there it's on the order of like 300 to a 1000, so it depends on what you're talking about. And I have seen jets that just break up immediately. There -- when I say there's no data --

MR. CATTON: This is a gas jet.

MR. HOPENFIELD: I understand. It's not a gas jet.

MR. CATTON: There is data on a high pressure ratio gas jet.

MR. HOPENFIELD: It's not a gas jet. It's a gas jet loaded with particles.

MR. CATTON: Okay.

MR. HOPENFIELD: It's somewhere between fluid and gas.

MR. CATTON: It acts like a gas.

MR. HOPENFIELD: Well, it probably is more than 2. We're getting something -- the relevant point is that I made the assumption that it's 2 based on -- it's a judgment call. I believe it's higher, but that's what I use, 2. So you can perturb it any way you want to. You can go to 1.5 if you wish. I believe it's going to be more than 2. But if you take that 2 and you take this time scale, you come up with leak rates which are huge. Now you can start playing with these numbers because it goes exponentially like 2 to the N. So if you take 1.5 or you want more than 2, if you run research you can come to something else.

The main point here is not to go to the detail of modeling this thing. The main point what I'm trying to get across here, there is a mechanism to propagate this thing very fast.

Now let's go back to reality check. I happen to spend at least a year or two thinking of these problems in connection of the design basis for the ABWR where we had -- in the steam generator the problem was a little bit different, but some of the basics were very much the same, although you have sodium-water chemical reactions involved. I think I'm repeating myself, but we came up with something like I believe for the design basis like 10 tubes, there was an accident four years ago at Dunray and

there were 40 of them that went.

So this idea of propagating them from one tube to another is not something that I'm inventing here. I'm not. The concept of damaging next tubes have occurred in craft boilers where millions of dollars were lost. So this is not something -- I do not have the data for this and I'm not going to say that these numbers really -- you're going to worship these numbers, because they're not.

It's an indicator here and that's what is important. It's the indicator that's important. But that's what I'm trying to get across. But for four years what I have been seeing and NRR has been walking away from that. It's not there.

Well, obviously this is ridiculous, this kind of number, so what you can say,well, I'm going to focus on the supercell including only 4 and I'll come up with a number which is obviously it's controlled by the choking flow from the maximum area that you have and that would be equivalent to a flow of four tubes.

So this is where the 250 comes.

MEMBER KRESS: So that's four times the leak out of --

MR. HOPENFIELD: It's four tubes is basically what it says.

MEMBER SHACK: It's the leakage from what in these four tubes?

MEMBER KRESS: From inside the tubes through the steam side.

MR. HOPENFIELD: This indicates that you're going to have very fast propagation. Obviously, when you have more holes in one tube, obviously they're going to be probably adjacent tubes. But if you take this number of tubes, I mean holes on one tube would exceed what you would have by the incoming flow through the cross section of the tube which is controlled by the choke flow. So all you've got to say is I really -- I cannot get more than what I would have passing through the four tubes.

MEMBER SHACK: Okay, I guess I'm -- how did you scale from a situation in which your leakage in a steam generator is measured in fractions of gallons per minute to a situation now where the leak rates are hundreds of pounds per second?

MR. HOPENFIELD: I didn't scale anything. In the case of what you have fraction -- during normal operating -- you're talking about normal operating conditions.

MEMBER SHACK: Right.

MR. HOPENFIELD: Okay, during normal operating condition I have minute flows that I'm not even concerned

about that. All I'm saying I'm going now to a transient and maybe I should have gone back and described the transient. I'm going to a situation where the secondary side on the steam generator is empty. I have a tube, would steam it --

MEMBER SHACK: So I've upped the pressure.

MR. HOPENFIELD: The pressure is at 2500 pounds.

MEMBER SHACK: You've upped the pressure.

MR. HOPENFIELD: Now if there's a little crack that's what is going to propagate. I didn't have that situation --

MEMBER KRESS: So he's saying that's choke flow out of that size hole.

MR. HOPENFIELD: The 25 -- you cannot have more than choke flow.

MEMBER KRESS: Yes. You take a .001 inch hole and put choke f' · through it. That's what he said you get.

MR. HOPENFIELD: If you have millions of those holes, you cannot have more choke flow than you go through the inlet of the tube.

MEMBER POWERS: What's the choked flow through .001 inch hole?

MR. HOPENFIELD: Pardon?

MEMBER POWERS: What's the choked flow through --

MEMBER KRESS: I'm assuming it's 2600 feet per second. I've not calculated it.

MR. HOPENFIELD: I'm using what the NRR people calculated. They're better at calculating things.

MEMBER FONTANA: Bear with me for a second, Joe. What's 1.6 times 10 to the minus 5?

MR. HOPENFIELD: If you take one micron, one mil, to get you a feel for what a mil is, it's about the size f your hair. You can see it. You take one mil hole and start throwing leaking through -- steam through it.

Then that jet is going to hit the next one.

MEMBER FONTANA: Right.

MR. HOPENFIELD: And then it's going to hit the next one and it will propagate all around. I'm saying when it hits the next one, it spreads a little bit, so it affects, it gives you a bigger hole. It's much more complicated. I'm simplifying because I really don't have that much time.

MEMBER FONTANA: What is 1.6E-5?

MR. HOPENFIELD: Okay, so what happens if you take the -- well, the 1.6 comes from the - it's simply density times the velocity times the area --

MEMBER KRESS: It's pounds per second.

MR. HOPENFIELD: It's called rho V. It's a continuity of mass.

MEMBER FONTANA: For that little one?

MR. HOPENFIELD: For that little one. I used the rho -- I don't remember what I used, but I used the atmospheric, the velocity is at 2500 and --

MEMBER FONTANA: Okay.

MR. HOPENFIELD: If you want to be accurate, you can go and use the density of the choke flow condition and you can keep on doing it.

The idea here is to give you --

MEMBER FONTANA: Now what's a 2 to the N?

MR. HOPENFIELD: Okay, each time that that jet hits the adjacent tube, it spreads a little bit.

MEMBER FONTANA: Right.

MR. HOPENFIELD: So the area, the effective area is going to be twice, actually probably is going to be much more. Yes. The next one keeps on going. Now you have -- now the next one opens up and you'll have twice as much flow coming out of there and keep on going.

MEMBER FONTANA: Okay, so N then is a number -- every time it fails it doubles is what you're saying?

MR. HOPENFIELD: Correct. No, that's two. The doubling is two.

MEMBER FONTANA: That's right.

MR. HOPENFIELD: Instead of 2 you can put 1.5, if you wish, or put 5 or put whatever you want.

The time here is 9,000 divided by 30. The 30 is -- this gentleman, the NUREG time, I mean the NRR time and the 9,000 comes from the fact, from the beginning of the accident, that's the time scale we're dealing with.

MEMBER FONTANA: Okay. So once it gets big enough to equal the area four tubes --

MR. HOPENFIELD: Then I said well, listen, I'm getting a ridiculous number that doesn't make any sense.

MEMBER FONTANA: That's right.

MR. HOPENFIELD: So I'm going to look at 4 because 4 sits next to it and I'm going to say I'm not going to have more than I can get through that 4.

MEMBER FONTANA: I've got it.

MR. HOPENFIELD: That's the number. Now you an argue whether it's 250, but really that's insignificant, but if you want 100, 100 fine, but what you've got to compare and the bottom line here is going back to this draft. That is the bottom line. When you have 250 and you have 4 pounds, the first thing you make it balance and you don't build a program that takes 3 or 4 years to figure out that it gets some other result. That's really what the bottom line is.

MEMBER KRESS: So you put 4 in as N, 2 to the

4th times --

MR. HOPENFIELD: Sir?

MEMBER KRESS: 2 to the 4th?

CHAIRMAN SEALE: No, he said he cut four tubes this way. He limited this thing to the mass flow through four tubes.

MEMBER KRESS: Yes, that's 2 to the 4th times 1.6 times 10 to the minus 5?

MR. HOPENFIELD: 2.6 -- no, it's probably much larger, but I said I don't want to deal with it. I don't really -- all I want to show you is I can have large leakages and when you have large leakages and you have such a small counter flow in the system, don't worry about the counter flow, worry about what the leakage does to you.

MEMBER KRESS: I understand.

MR. HOPENFIELD: And that's really the answer. That's really what I'm doing here, nothing else. There's nothing genius about this.

MEMBER POWERS: I guess this side of the table still is lost a little bit.

When I look at a one mil hole with a 2600 foot per second jet going through it, I get a flow rate of like .4 of a cubic centimeter a second. That means I'm going to have an awful lot of these little holes to get up to

anything close to a pound a second?

MR. HOPENFIELD: You're correct. You've got many, many holes in here because it keeps doubling up.

MR. CATTON: If your steam generator is operating such that it's just below detection as far as leakage, what size hole is that?

MEMBER POWERS: Well, we have a criterion --

MR. CATTON: Is it based on gallons per day or something?

MEMBER POWERS: That's right.

MR. CATTON: If I have that many gallons per day, what hole size does that translate into?

MEMBER SHACK: Well, do you attribute it all to a single crack or how many cracks do you postulate?

MR. CATTON: Just contribute it to an area. Anyway you want.

MR. HOPENFIELD: I think it's going to be very small.

MEMBER POWERS: If somebody could remind me what the --

MR. CATTON: Much less than the .001?

MR. HOPENFIELD: I think it's going to be much less than .001, right. Very, very small. It's in the liters per -- I forgot the numbers, but it's in liters per minute.

MR. CATTON: You see, under those circumstances you've got a couple of hundred psi and now you've got 1,000 psi, 2,000 psi across the hole.

MEMBER POWERS: Could somebody remind me what the leakage criterion is?

MR. STROSNIDER: Jack Strosnider, staff. The technical specification limits are about .3 gallons per minute, 150 gallons per day. It's been reduced to, for some of the plants that have a lot of degradation. Those numbers were based on trying to assure a leak before a break condition basically, such that if you detect that amount of leakage, the flaw size should be less than the critical flaw size at normal operating pressure which is getting up somewhere around I think three quarters of an inch to an inch, maybe something like that.

MEMBER SHACK: Now that's at main steam line?

MR. STROSNIDER: That's at main steam line break.

MEMBER SHACK: I think it's about half the length of the crack at main steam line break, so it's roughly a half inch crack.

MR. STROSNIDER: Okay, at main steam line break, right. And I don't know the exact numbers, but the numbers that correspond to that primary to secondary leakage, I believe there are some factors of safety in

there too, but it's a larger flaw size than what you're talking about this one mil hole. It's significantly larger than that. It's a half inch crack, I think.

MR. CATTON: Larger than the one mil hole?

MR. STROSNIDER: Yes.

MR. HOPENFIELD: I don't have a slide of this thing but five years ago, the Belgians made a presentation with this regard and I think it's relevant to your question, sir. And they said that there's no way that it's completely a different phenomena. There's no way of taking these kind of leak rates that you see during normal operations and even talk in terms of the content that we're talking about.

I don't have a slide of it, but I'd like to pass this around.

MR. CATTON: I don't understand why there isn't?

MR. HOPENFIELD: Well, because -- here's the calculation. Why there isn't?

MR. CATTON: Yes.

MR. HOPENFIELD: Because the pressure and the opening of the crack, they mention plugging the crud is two different things.

MR. CATTON: You've got to start with something and --

MR. HOPENFIELD: You've got to start --

MR. CATTON: I could see where you could make the argument just below the detection limit, that should define somehow --

MR. HOPENFIELD: I have plugged tubes according to - a lot of plugged tubes that open up the pressure.

MR. CATTON: What happens when they do two things? One, I switch to a gas flow and two, I increase the pressure drop across the tube by a factor of ten.

MR. HOPENFIELD: And a third, you're opening up the latter there because of the crud was crudded and it was plugging it under normal condition. Now you open it up and that has been observed experimentally.

MR. CATTON: I'm not disagreeing with you.

MR. HOPENFIELD: Okay.

MR. CATTON: I'm just trying to understand.

MR. HOPENFIELD: Yes.

MR. CATTON: So how much would the crack open?

MR. HOPENFIELD: How much?

MR. CATTON: I already heard that it's probably greater than .001.

MR. HOPENFIELD: Well, I'm sure. I just took the arbitrary-- you can take larger, but they've got about a factor of 100 opening here. I just used, I went as

small as you can to indicate to you, just to get around all those questions how small is small, how large is large. I start with the smallest one.

MR. CATTON: You can argue that some value is as large as you could ever expect and you can calculate the mass flow and it's a number that's too small to worry about, the problem is over.

MR. HOPENFIELD: Right, but I don't think you can. That's the problem.

MR. CATTON: I'm trying and I'm trying to have your help.

MR. HOPENFIELD: I don't know how and I'm just telling you -- I don't know how to get the opening. You can use some elastic plastic analysis and figure out how much a little crack would open up.

MR. CATTON: I can't do an elastic plastic analysis. That's a little too stiff. I like it to be more viscous.

MR. HOPENFIELD: If you do that, you get very large flow rates. You really will because if you use the normal K delta P to get the opening of that crack, you get -- this is a factor of 100 here, I guess.

And their conclusion, because of the plugging that you can't do that and I agree with that. By the way, this thing is documented in one of the ACRS meetings.

CHAIRMAN SEALE: Well, could I ask is this question going to be addressed in the report that the staff has prepared?

MR. STROSNIDER: I'm sorry, I didn't --

CHAIRMAN SEALE: Should the question be addressed the report that you are preparing in response to Dr. Hopenfield?

MR. STROSNIDER: Yes, we've done analysis in this area and we can include it in the report. I would comment, as we presented it yesterday that the frequencies you saw containment bypass, what was built into that model is if you have a quarter inch through wall flaw that it leads to tube failure based on this phenomena and that's represented in the frequencies that were shown. Of course, this is dependent upon the frequencies you see in that type of flaw.

CHAIRMAN SEALE: Sure.

MR. STROSNIDER: But we have done some analyses in this area and we can include them in the report.

MR. HOPENFIELD: Could I make a comment? It really wasn't my purpose here because I can only talk about thermal hydraulics. Since you mention that, you really have to watch it very carefully when they talk about the frequency. First of all, the support plate

cracks were not taken into consideration. There's a reference in this document to the fact that the aspect ratio is something like 4 to 5, given it's 4, it's less than .05 because there are a lot of tubes which are only 40 mils.

If you look at the aspect ratio, there's no reference that one could go through the data and see where it comes from and then really more important than anything else, you already worry about well, those cracks were just about next to the surface, they're going to open up.

So I think just to throw numbers in the air, that's fine and I didn't want to get into that because that wasn't my subject here, but when the answer comes to the DPO, I think, I hope you'll address that instead of just throwing numbers which this document does.

CHAIRMAN SEALE: Are there anymore questions or comments?

MEMBER KRESS: I still don't know where the 260 pounds per second comes from. If somebody would write me an equation up there and say multiply this times this times this and get 260, it would be very helpful.

MR. HOPENFIELD: Can I answer your question, sir?

MEMBER KRESS: Yes sir.

MR. HOPENFIELD: Forget about the 260. The

only purpose here is to say there's a mechanism to propagate a leak very fast. It doesn't have to start with a large hole or a larger than .25 or whatever. That's very important. The 260 is just to get you a feel because some other person would have asked me where is the number.

MR. CATTON: And I think Tom, what he's saying is you have any leaks the first thing you have to think about is will the aerosols or particles or particulates or whatever is in the flow cause erosion and make that hole bigger. That's one.

The second is will the jet from this leak impinge on an adjacent tube? If the hole is small enough, the aspect ratio of the jet is a number of diameters away is very large, most of it's going to attenuate and probably not. But as the hole grows, it certainly could.

So I don't know if we know how to even begin to answer that kind of a question, unless we can address the question of what's being carried with this flow, because it's probably the aerosols that are going to cause the problem.

MR. HOPENFIELD: Absolutely.

MEMBER KRESS: Those are liquid droplets.

MR. CATTON: Well, any kind of liquid or anything that's carried as a particle of the flow will cause erosion. Now I know at higher temperatures because

we have lots of examples in the rocket business and blowing out elbows and with aluminum oxide, for example. It just cuts like a torch.

Now here the temperatures are a lot lower. I mean they are nowhere near the same kind of temperatures, but on the other hand, you've got 9,000 seconds for something to happen. I just don't know how all that plays -- you can actually lay it out. You can first, what is the probability of the pinholes, .001 or any size. And then for a given hole size and pressure ratio, what is the probability the jet will damage an adjacent tube?

What's the leakage rate through the pinhole? How fast will the pinhole grow and how big can a hole be during normal operation and not be detected?

I don't know, but it seems to me these kinds of questions could be answered.

MR. HOPENFIELD: I think all your questions -- you didn't miss anything, you just hit the nail on the head. You are absolutely right, but the bottom line is people out there in the field, they're not interested in these kind of problems. They don't look at that kind of minute detail to calculate these kind of things.

So you don't have the data. I think the only one that I've looked at, and NRR found the relevant data on the material because it's the material, it's the

particle size. It's the particle concentration. It's the distance of the jet. It's the velocity and if you keep on going, I don't know what it is and I don't think anybody without spending several years running some kind of experimental program will find out.

MR. CATTON: I think the first thing somebody ought to do is sit down and just walk through some of this.

MR. HOPENFIELD: They have tried. They came up with this thing.

MR. CATTON: I guess I don't know what this thing is.

MR. HOPENFIELD: Well, they came up with data from superheater erosion of a superheater tube which are usually on those plants, if I remember, they were running at pretty high temperature and they were at like at 1000 pounds or so. What they had in the experimental program to measure what the erosion rate is going to be from a little pinhole, but the tubes, I think, were much thicker, but the time erosion rate was 5 -- there was a difference of a factor of 6. Correct me if I'm wrong --

MR. CATTON: This is an erosion rate due to a hot gas without any particulates?

MR. HOPENFIELD: No, with and without particulates.

MR. CATTON: With and without particulates.

MR. HOPENFIELD: Yes, it's on page -- what page is this? Jack, what page is this? I'll give you the exact

--

MR. STROSNIDER: I don't have the report with me.

MR. HOPENFIELD: Here, I have it. I have assumed that you've seen this report.

MEMBER FONTANA: I remember it

MR. HOPENFIELD: Because of the time limitation I assumed that you had seen this.

4-12, I think.

MR. CATTON: 4-12.

MR. HOPENFIELD: Okay, he's got 4.9 seconds for clean tube and 62 seconds for jet with particles. I took the in-between there. That's where the 30 seconds comes from. I eyeballed it.

Jack, do you remember what the spacing was on these?

MR. STROSNIDER: I'm sorry.

MR. HOPENFIELD: Do you remember the spacing between the superheater tubes on this?

MR. STROSNIDER: No, I don't. Unfortunately, th staff members who did that calculation aren't here

right now. We have that information.

MR. CATTON: The time to failure is 4.9 and 62.6.

MR. HOPENFIELD: That's whether you have particles or not which would make sense.

MR. CATTON: Then they agree with you?

MR. HOPENFIELD: Yes, I took their data. They don't agree with me. I took their --

CHAIRMAN SEALE: He averaged their number.

MR. CATTON: Okay.

MR. HOPENFIELD: The only thing that you may want to argue here is to come up with whether you have a doubling up. I didn't want to get into the details of the mechanism here, but what you have you're eating through the next tube, but as you finish eating the next tube, now you're going to high pressure jet come from the other side and which will deflect the other one, but that high pressure is going to erode the hole anyway you get into a situation where we can write a Ph.D. thesis, but it's just not worth the time. It's a mechanism from propagating something very fast and I think we ought to accept that.

CHAIRMAN SEALE: Well, I think we certainly will have to look at this carefully. We want to see what your response report looks like as well as the report we have here and we thank you very much for keeping our

attention focused on this matter here, sir.

MR. HOPENFIELD: Thank you very much.

CHAIRMAN SEALE: It's of serious concern.

MR. HOPENFIELD: Thank you for allowing me the time.

CHAIRMAN SEALE: We appreciate your time and preparing and bringing this to our consideration.

I guess we're at the witching hour. I want to thank the staff. I want to thank the industry for their comments and their tolerance of our schedule.

What else can I say? Is there anything else? We're adjourned.

(Whereupon, at 12:00 p.m., the meeting was concluded.)

C E R T I F I C A T E

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

Name of Proceeding: Advisory Committee on Reactor Safeguards Joint Meeting: Materials and Metallurgy & Severe Accident Subcommittees

Docket Number: n/a

Place of Proceeding: Rockville, MD

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.

Corbett Riner
Official Reporter
Neal R. Gross and Co., Inc.

INTRODUCTORY STATEMENT BY THE CHAIRMAN OF THE
MATERIALS & METALLURGY AND SEVERE ACCIDENTS JOINT SUBCOMMITTEE
11545 ROCKVILLE PIKE, ROOM T-2B3
ROCKVILLE, MARYLAND
MARCH 4-5, 1997

1

The meeting will now come to order. This is the second day of the meeting of the ACRS Joint Subcommittee on Materials & Metallurgy and Severe Accidents.

I am Robert Seale, Chairman of the Subcommittee.

The ACRS Members in attendance are:

George Apostolakis, Mario Fontana, Thomas Kress, Dana Powers, and William Shack. The ACRS Consultant in attendance is Ivan Catton.

The purpose of this meeting is to hold discussions with representatives of the NRC staff, to gather information concerning the technical basis and regulatory analysis associated with the steam generator tube integrity rule and related regulatory guide. The Subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions as appropriate, for deliberation by the full Committee.

Noel Dudley is the Cognizant ACRS Staff Engineer for this meeting.

The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in the *Federal Register* on February 14, 1997.

A transcript of the meeting is being kept and will be made available as stated in the Federal Register Notice. It is requested that the speakers first identify themselves and speak with sufficient clarity and volume so that they can be readily heard.

We have received no written comments from members of the public. One individual requested time to make an oral statement at the end of the meeting.

Today the Committee will hear from the staff and its contractor concerning the regulatory analysis.

We will proceed with the meeting and I call upon Mr. Tim Reed, Office of Nuclear Regulation, to begin.

DETAILED ANALYSIS OF SG RULE VALUE-IMPACT APPROACH

- General equation for values and impacts:

  NV= V1+V2+V3+V4+V5 - [I1+I2] where:

  V1= avoided public risk [person-Sieverts (Sv) and $200k/per-Sv]
  V2= avoided occupational risk w/accident mgmt [person-Sv]
  V3= avoided offsite property risk [$]
  V4= avoided onsite financial risk-cleanup/power replacement [$]
  V5= decrease/increase in routine occupational dose [person-Sv]

  I1= costs to NRC [$]
  I2= costs to licensee [$]

  All $ are 1997 $'s

- V1, V3, and V4, dominate the calculation on value side (V2 and V5 are not discussed herein)

DETAILED ANALYSIS OF SG RULE
AVOIDED PUBLIC RISK

- Utilized ΔLERF to calculate avoided public risk (V1):

  V1 averted public risk in $'s = (ΔLERF)(Conditional Conseq)($/Person-Sv)(#PWRs)(Discounted Lifetime)

  - Conditional consequences utilized SST1 values from NUREG-2239 and values from NUREG-1570 ($2X10^4$ person-Sv)

  - Consequences were then ratio'd for each PWR by $(SST1_i/SST1_{Surry})(Power\ level_i/Power\ Level_{Surry})$

DETAILED ANALYSIS OF SG RULE REMAINING VALUES

- Calculation of averted offsite damage (V3) similar to averted public risk:

  V3 averted offsite damage in $'s = ($\Delta$LERF)($ for Surry large release)(Discounted lifetime)--scaled for each of 73 PWRs by $(SST1_i/SST1_{Surry})$(Power $level_i$/Power $Level_{Surry}$)

  - Used NUREG/CR-2723 for property damage values converted to 1997 $'s

- Calculation of averted onsite financial risk (V4):

  V4 averted onsite financial risk in $'s = ΔLERF[(power replacement) + (cleanup)] (Discounted lifetime)(#PWRs)

  - where NUREG/CR-4627 adjusted to $1997 is used for power replacement estimate and cleanup

DETAILED ANALYSIS OF SG RULE RESULTS CONT'

- Net value for just the risk portion of the draft rule is a modest positive $700k/plant--remember:
  - Used a relatively bounding ΔLERF
  - Assumed 10 high risk PWRs (contribute 2/3'ds total risk)
  - Did not include the actual costs to achieve the assumed ΔLERF
- Considering the initial assumptions, the staff concluded that further refinement of the estimate was not necessary and that the actual net value would be very small or even negative (costs outweighing values)

HO
2

COMPILATION OF CONCERNS

Committee report issued on November 20, 1996

I. Difficulty in reaching agreement on the performance criteria

II. Incomplete and sometimes perfunctory analyses required to provide an assessment of relative risk

III. Reliance on core-damage frequency alone as an indicator of risk

IV. Recourse to defence-in-depth without specific criteria for its use

- Inclusion of programmatic elements in regulatory guide
- Requirements for NDE supplemental performance demonstrations
- Limit of 20% of the conditional probability of burst criteria for each degradation mechanism
- Deterministic structural criteria use of a safety factor of 3 times the differential pressure across steam generator tube at normal operating pressure
- Assumptions used in thermal-hydraulic codes, bounding versus best estimate
- Assumptions used in flaw-distributions
- Assumed reliability of components in event trees, primary relief valves assigned low failure probability versus secondary relief valves assigned high failure probability
- Operator actions not considered in the event tree scenarios

V. Recommendations

- Allow licensee to consider risk instead of frequency. i.e. allow credit for steam generator as a filter
- Rewrite the regulatory guide to state the risk objectives and how the objectives will be assured by the performance criteria
- NRC should review and approve the methodologies developed by the utilities to demonstrate conformance with the performance criteria [the Committee suspects there is no cost savings in inspecting the methodologies after the fact]
- Encourage the staff to consider the industry concerns about overly conservative assumptions required to in the deterministic criteria
- Resolve the professional differing opinion and Generic Safety Issue 163 before implementing the steam generator rule.

Comments On The Thermal-Hydraulic Analysis In NUREG-1570

ACRS Materials and Metallurgy Subcommittee
& Severe Accidents Subcommittee

March 5 , 1997

Joe Hopenfeld
GSIB/DET/RES

My reason for commenting on NUREG-1570

- **The results of the document are not valid because leaks through degraded tubes are ignored**

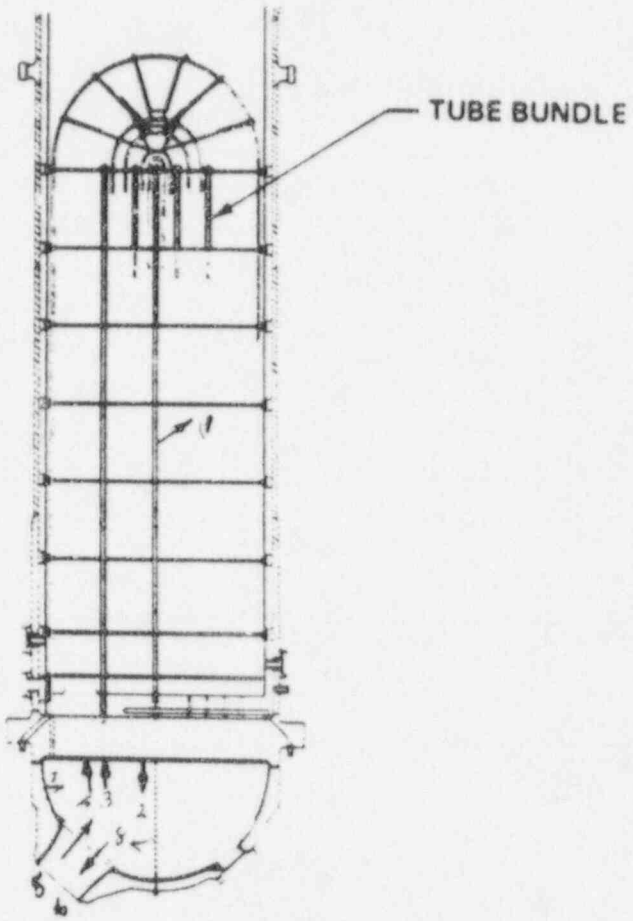
- Comparison of DPO & NUREG-1570 Results

Reference	Failure Mode	CONTAINMENT BY PASS FREQUENCY
HOPENFELD DPO- Memo To Beckjord (Effect of degraded tubes on risk from severe accidents, Sept 11, 1992)	SG tubes fail before surge line	1.6 E-5/year
DRAFT NUREG-1570 (Feb. 1997)	Surge line fails before SG tubes for most sequences	3.3 E-6/year

- Comparison of DPO & NUREG-1570 Assumptions Regarding Mixing In SG Inlet Plenum

	DEGREE OF MIXING
DPO	None
NUREG-1570	0.87

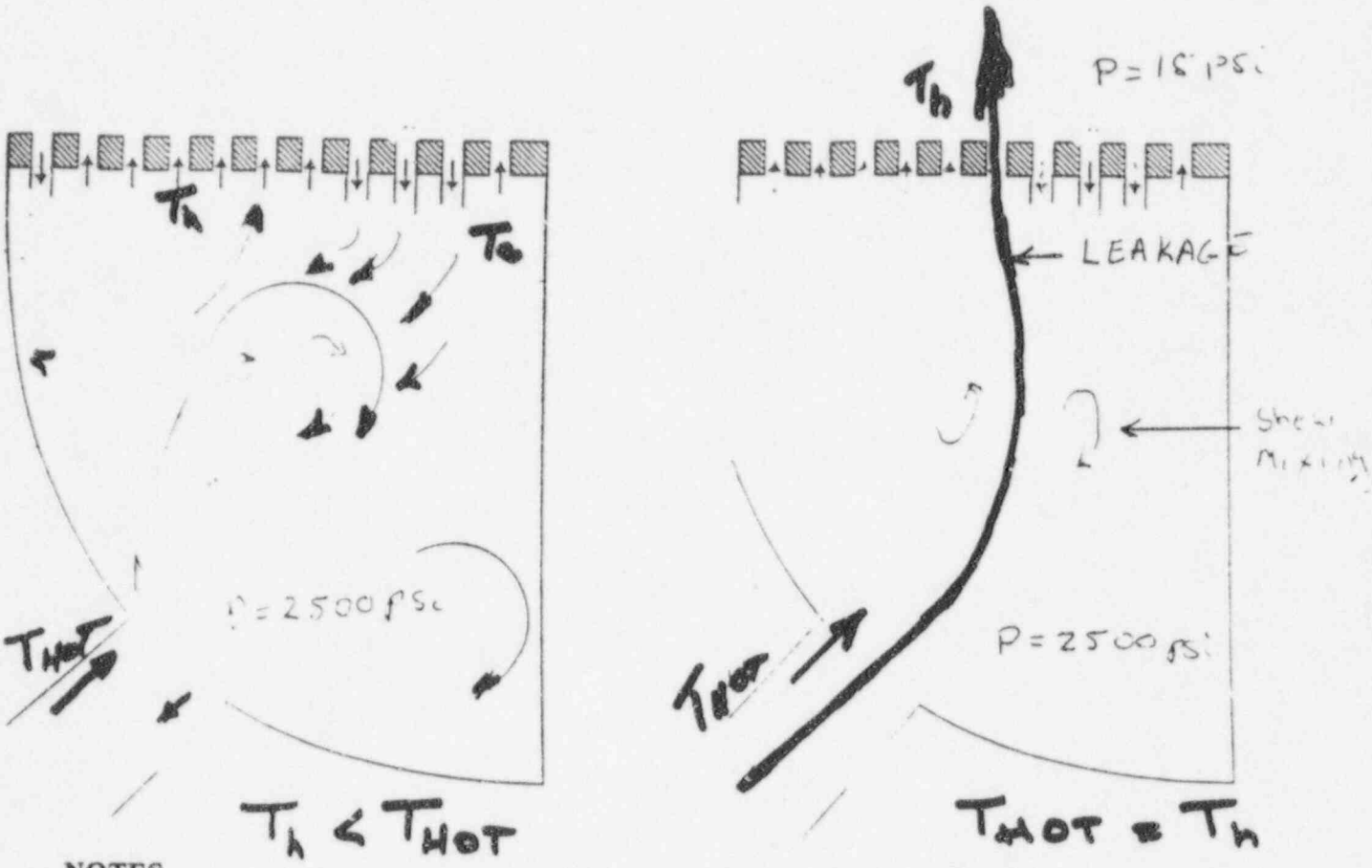
MIXING OF STEAM STREAMS IN THE INLET SG PLENUM



(1) Flow from leaking tubes into the secondary side
(2) Return flow from outlet plenum
(3) Forced convection flow (leakage)
(4) Free convection flow (buoyancy)
(5) Counter flow (hot)
(6) Counter flow (cold)
(7),(8) Wall flow due to local temperature differences

Leaking Tubes Flow, (1) = 10 - 250 Lbs/sec
Counter Flow, (5) = 4 Lbs/sec

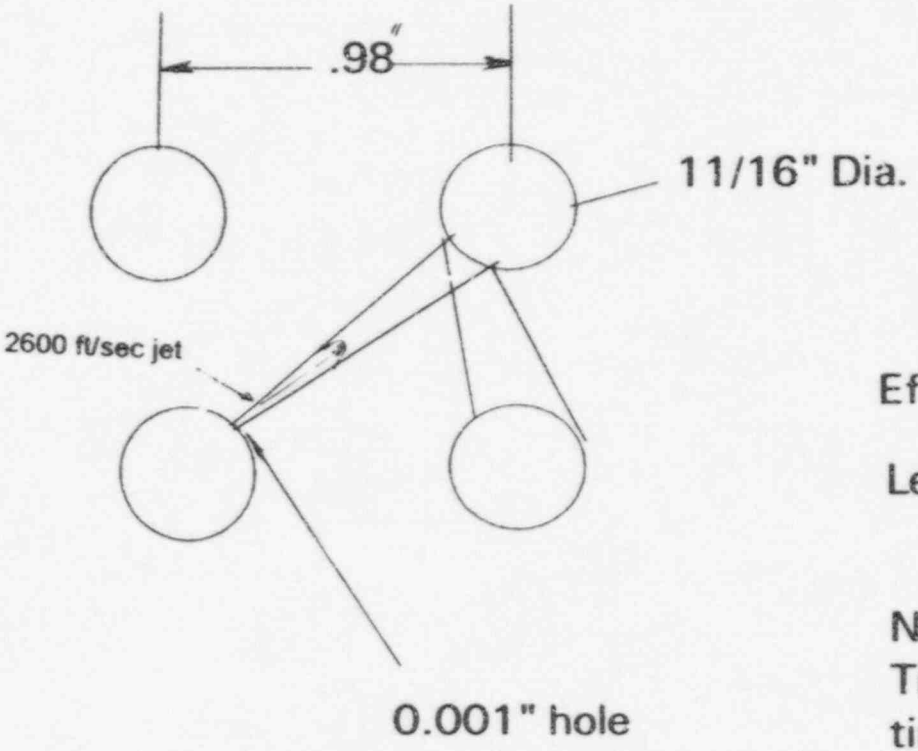
- Comparison between mixing (left) and non mixing models (right)

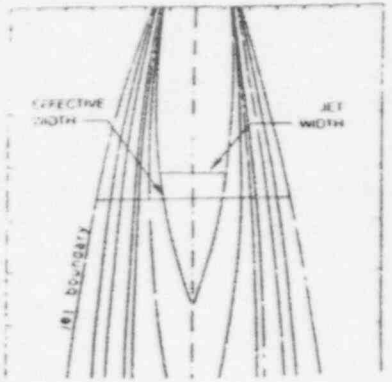


NOTES

- Mixing decreases tube temperature rise rate in comparison to the non mixing case
- NUREG analysis is based on 1/7th scale tests where there was no mixing
- Sensitivity studies which are based on 1/7th scale test data have no physical meaning. If the tests were conducted with leakage the flow pattern would have been different
- Varying the number of hot tubes and circulation ratios may be applicable when the counter flow is larger than tube leakage.

Schematic of Tube to Tube Propagation Due to 0.001" Thru Wall Defect





Effective jet width/crack size = 2

Leakage = $1.6E\text{-}5\ (2)^{N}$ lbs/sec

$= 1.6E85$

N = Time for propagation = Time to surge failure/Drilling time = 9000/30

CONCLUSIONS

(1) Tube to Tube Damage May Propagate Very Fast
(2) Damage to Four Tubes is a Reasonable Assumption
(3) 4 Tube Equivalent Leakage =260 lbs/sec

CONCLUSIONS

Risk Assessment of Severe Accident Induced Steam Generator Tube Rupture depends on the validity of the thermal-hydraulic analysis.

- **KEY ASSUMPTIONS IN THE NUREG REPORT ARE INCORRECT**
- **THE TREATMENT OF UNCERTAINTIES *DOES NOT COVER THE PROPER PARAMETERS***