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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

480TH MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

THURSDAY

MARCH 1, 2001

ROCKVILLE, MARYLAND

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

COMMITTEE MEMBERS:

GEORGE APOSTOLAKIS, Chairman
MARIO V. BONACA, Vice Chairman
THOMAS S. KRESS, Member
GRAHAM M. LEITCH, Member
DANA A. POWERS, Member
ROBERT L. SEALE, Member
WILLIAM J. SHACK, Member
JOHN D. SIEBER, Member
ROBERT U. UHRIG, Member
GRAHAM B. WALLIS, Member
F. PETER FORD, Invited Expert

NRC STAFF:

RALPH CARUSO
TIM COLLINS
NOEL DUDLEY
CHRIS GRIMES
BILL HUFFMAN
RALPH LANDRY
RONALD LLOYD
JOHN NAKOSKI
BOB PRATO
HAROLD VANDERMOLEN

OTHERS PRESENT:

LYNETTE HENDRICKS
ROBERT HENRY

SCHEDULE AND OUTLINE FOR DISCUSSION
480TH ACRS MEETING
MARCH 1-3, 2001

THURSDAY, MARCH 1, 2001, CONFERENCE ROOM 2B3, TWO WHITE FLINT NORTH, ROCKVILLE, MARYLAND

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

8:30 a.m.

CHAIRMAN APOSTOLAKIS: The meeting will now come to order. This is the first day of the 480th meeting of the Advisory Committee on Reactor Safeguards.

During today's meeting the committee will consider the following: RETRAN-3D Thermal-Hydraulic Transient Analysis Code, Interim Review of the License Renewal Application for Arkansas Nuclear One, Unit 1, Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants, Management Directive 6.4 Associated with the Revised Generic Issue Process, and Proposed ACRS Reports.

I would like to note some changes to the agenda. RETRAN-3D and ANO-1 license renewal application were discussed by cognizant subcommittees. As recommended by the chairman of the subcommittees, there will not be presentations either by the staff or by the industry groups on these matters. Instead the subcommittee chairman will provide reports to the full committee. Representatives of the NRC staff will be present to answer any questions from the members.

In addition, the subcommittee report on the South Texas Project Exemption Request scheduled

between 1:00 and 1:30 P.M. on Friday, March 2, will be held today following the subcommittee report on RETRAN-3D.

After completing the subcommittee reports, the committee will discuss the proposed ACRS report on the regulatory effectiveness of the ATWS Rule. I hope these changes will not cause any inconvenience to the meeting participants.

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

We have received no written comments or requests for time to make oral statements from members of the public regarding today's sessions. A transcript of portions of the meeting is being kept and it is requested that the speakers use one of the microphones, identify themselves, and speak with sufficient clarity and volume so they can be readily heard.

I will begin with some items of current interest. We received from Dr. Powers draft one of the research report on February 26 and some additional sections yesterday. The most recent version of the

research report along with assignments for reviewing various sections will be provided to you this morning.

Members should not only review the sections assigned to them but also should review the entire report and be prepared to provide their views during the discussion of the report this evening. Representatives from the Office of Research will attend the meeting to respond to questions from the members.

I would also like to bring the members' attention to this pink items of interest report, in particular items referring to management changes. There have been some senior management changes.

Also to the announcement that the NRC will hold a workshop on the initial implementation of the reactor oversight process on March 26. Also the agenda and registration information for the NRC 13th Annual Regulatory Information Conferences included in this document.

I think we are ready to start the meeting. The first item on the agenda is RETRAN-3D Thermal-Hydraulic Transient Analysis Code.

Dr. Wallis, will you guide us through this and give the report to the committee.

DR. WALLIS: Thank you, Mr. Chairman. We

met on the 20th of February, last week, with representatives from EPRI and from industry, the users of EPRI code RETRAN.

Finally, with the technical folks who are consultants for EPRI who actually put together the code. We actually this time had discussions of technical matters which had eluded us two years previously and for some time in between.

Mr. Swindelhurst from the users gave us the familiar story, RETRAN is being widely used, ACRS concerns have been addressed, and everything is fine.

We then turned to Mark Polson, the technical man. He made a technical presentation. Before long he realized that our critique had some merit. He said things like, "Oh, I see where you're coming from," and expressions like that which it was quite nice to hear.

After this had gone on for an hour or two, the new program manager from EPRI who wasn't here the previous time, Jack Prahl, asked to make a statement and he essentially wished to admit that there were problems with this code and EPRI had something to fix up.

Then we went on with more technical details and more discussion with Mark Polson and he saw even more clearly some of the places from where we were

coming. It was decided from the results of these discussions that it would not be appropriate for EPRI to make a presentation today before the full committee which was originally planned.

That's a brief overview of what happened last week.

Now, I think it will be good for this committee to discuss quite a few points raised or lessons learned from all this. I'm sure you have some other than the ones I wish to point out at this time.

First one is the ACRS role. It seems that without the willingness of the ACRS to actually look at equations and question them, none of this might ever have happened. One wonders if it really should have to come to the ACRS in order for this sort of review of equations to occur.

The staff has issues with the SER and one might wonder what the mechanism is now for closing the loop on these issues. Will the documentation have to be changed since the code reflects the documentation?

And since the problem with the RETRAN momentum equation is the supposed resolution, if the momentum flux turns in arbitrary direction psi which leads to peculiar results, this presumably is in the

code. Will the code have to be changed? If the code has to be changed, the evaluations of the code will have to be rerun and so on. There are a lot of issues about what should happen now.

The shorter-term issue for us is what should we do now. I understand the latest proposal is that this committee write Larkins a very short letter -- you may even have the draft of it here -- and append the two documents that I prepared, the tutorial on the momentum equation and the detailed critique of RETRAN which doesn't necessarily capture everything in there which might need examination and change.

I think my colleagues might consider at this point what we are aiming at as a resolution of these matters. What do we hope to change? Do we hope to change the way things are done around here? Do we want to change the way reviews are performed? Do we want to change substantially the standards required for code documentation?

Do we want to change RETRAN code itself? What is it that we hope to achieve by our actions today and in the future on this code and other codes? There are several questions. Maybe the chair would like to decide which ones to take up first.

CHAIRMAN APOSTOLAKIS: I'm not sure this is

the appropriate time to do this. We will perhaps revisit these questions when we draft this short letter and decide what the attachments should be.

DR. POWERS: I wonder why you think it's not the appropriate time.

CHAIRMAN APOSTOLAKIS: This is supposed to be a short proposal. The questions that Dr. Wallis is raising are require a lot of discussion.

DR. WALLIS: The staff is or are here, depending on grammar. There are members from the staff here and this is your chance to have a discussion with them about perhaps how we got here and where we go from here.

CHAIRMAN APOSTOLAKIS: It seems to me that regarding the code we have to make sure it's correct. But the other questions you're asking, where do we want to go and whether we want to make proposals regarding the review process, I mean, I don't think this is the right time to discuss that.

DR. POWERS: It seems to me that the review process itself is pretty good. I mean, I am impressed at all the things that are going on, getting the code, running it, very carefully going through all the things like that.

Now the question of the documentation and

what not, it seems to me it's not a change. It's simply exercising and reinforcing the standards in the technical community in general.

The documentation simply has to accurately reflect what is done in the code and has to be technically correct. You cannot have scalar quantities treated as vectors. That's just unacceptable, or vice versa.

CHAIRMAN APOSTOLAKIS: There are bigger issues here, though. I think that's what Graham implied. Why did it come to ACRS having to check the equations and find that they were not appropriate and so on? That should have been done somewhere else in the process. Is it the job of this committee to check equations and find mistakes?

I think that is an issue that we certainly need to discuss and maybe try to come up with some recommendations to the commission that will correct the process because we should be reviewing whatever we like but it seems to me that, you know, this should not be the place where errors of the type that Dr. Wallis identified should be found.

In that sense I don't think it's appropriate to discuss these bigger issues. But we definitely want to make sure that there is documentation of the

concerns and so on. This is simply intended to document these concerns.

Dr. Wallis has transmitted to us two reports that are in the handout No. 2, the first two, Comments on EPRI Response to RAI and Other Recent Submittals Concerning the RETRAN Code dated February 25 of this year. The second one is Tutorial on Momentum Equations dated January and February of this year.

The thought was simply to write a short letter to the EDO transmitting these two documents at this time. That's all the action we're going to take and wait for EPRI response.

Is that correct, Graham?

DR. WALLIS: Maybe you don't want to do it now but I think we have to have some idea of where we think things are going and where they ought to go because if we wait, we don't know what we're going to get. We may get off on some track which isn't going in the direction we would like things to go.

CHAIRMAN APOSTOLAKIS: Like which way?

DR. WALLIS: I don't know. This committee needs to decide what its role is. We could stand back and say we've given our input. Now we'll wait and see. Whatever comes back, we'll respond to that when we see it.

Or we could give more indication of where we would like things to go and what we would regard as a suitable resolution of the issues so that when folks come back to us, whenever they do come back to us, if they come back to us, with what they think is a resolution of the issues, that they don't find that our expectation was something different.

CHAIRMAN APOSTOLAKIS: Would you raise these issues and reflect our thoughts on the matter in the letter?

DR. WALLIS: No. I think we should probably discuss this at some other time, George, than in this meeting.

CHAIRMAN APOSTOLAKIS: That's what I'm saying. That would make a very difficult letter.

DR. WALLIS: Since we have two members of the staff here, do we want to ask them about the mechanism for closing the loop?

This is something that Virgil Shrock raises rather strongly in his comments is that we go through all these motions but the SER is out there and unless somebody follows up on these things the issues may just fade away and people get tired of them and nothing will happen. What is the mechanism for what one could call closure on these issues?

DR. LANDRY: Mr. Chairman, Ralph Landry, NRR staff. As we discussed with the subcommittee, our position at this point is we have prepared an SER based on the documentation which we received on RETRAN-3D.

Now, since we have been involved very heavily with the subcommittee in the review of the code, the errors in the documentation that was presented on the momentum equation, we've expressed our view that the approach that was taken in preparing this documentation was very difficult to understand and very difficult to follow through.

EPRI attempted to derive a momentum equation from basic principles and in that process ended up with material that was very hard to follow through and, quite frankly, we would agree with Dr. Wallis that it's highly suspect and there are errors in it. We pointed out a number of errors to EPRI and their consultants ourselves in addition to the errors that Dr. Wallis pointed out.

Our suggestion in front of the subcommittee was that the documentation should be retracted and a presentation should be made of what is in the code with regard to a motion equation, momentum equation, however you want to term it, what are the terms in

that equation, what do they represent, and how can they be justified rather than a derivation from basic principles.

EPRI in their presentation to the subcommittee indicated, as Dr. Wallis said, that they recognized the problems in what they had in the documentation. They were going to go home and do some further work.

At this point the staff is waiting to see what that further work is because we don't want to dictate to them what they should put in the documentation. It's their job to come up with the documentation. We want to see what is in that documentation, is it correct, and is it in acceptable form.

At that point we would entertain the idea of writing an addendum or a supplement to our SER. We have done that in the past. In the years gone by in code reviews there have been numerous SERs which had supplements and addenda written to them which explained further information or evaluated further information that had been received. We would be more than willing to do so should they provide information that is reviewable that would correct what we see as shortcomings in the documentation today.

That's the approach that we're on on RETRAN. Some of the other points that Dr. Wallis has brought out are a bigger picture discussion and those I think we need to discuss more fully and how we approach these reviews.

From the perspective of the staff, the review that has been undergone in the code in the recent two years with the TH subcommittee has been very good and very fruitful. We've had a very good relationship and very good interchange of information with one another and this has been a great benefit to the staff.

In this process we have been writing a draft standard review plan and draft regulatory guide on code and code review. This has been in itself an educational process. We've learned a great deal from these code reviews and from the interactions with the subcommittee.

DR. WALLIS: Let me ask you about the code itself. Just to pick one thing out of my critique here, they have an analysis of a bend. If you throw out the friction turn and it's a smooth bend, it turns out the way they formulated it, there's a pressure rise across the bend for no cause.

If you add these bends together, you've got

a pump with no moving parts and no energy input which doesn't seem very desirable. If these features are in the code itself, you have to after the code, not just the documentation.

DR. LANDRY: That's correct and that is one of the problems that we also pointed out and point out in the SER, that you don't get an effect as their equations would indicate. It would be a very creative piece of equipment. It's almost a perpetual motion machine that they have created in their derivation. It would be very nice to see if they could build one of these. That's a little sarcasm.

DR. WALLIS: They could have a dot com company which would flourish for a while.

DR. LANDRY: Until they went bankrupt. Typical dot com. That gets back, Dr. Wallis, to the point I was trying to raise a few minutes ago. The approach that we think would be far more fruitful and beneficial would be to show what is in the code, explain what is in the code, and why what is in the code is correct and acceptable.

Right now we're going down one path with documentation and that may not match up with the code. We keep saying to the applicant, "You should come back here and explain the code and why the code is

acceptable. What is in the code, not necessarily what is in the documentation.

MR. LEITCH: Dr. Landry, could you explain what is the status of the SER now and what use would be made of the SER where we are at this point in time?

DR. LANDRY: The SER has been issued to the staff and I believe the SER has been released into the public sector by the project's office. That means that those who would like to use RETRAN-3D can come in and reference the SER.

But that doesn't mean that anyone referencing the SER and RETRAN-3D is completely clean. There are 45 conditions and limitations stipulated in the SER on RETRAN-3D which puts a severe restriction on anybody using the code in that they must come in and justify every option chosen.

In most applications of the code provide adequate assessment because the assessment is so thin in the documentation for the application of the code. That puts a great deal of onus on anyone who wants to use the code in that they must completely justify what they are doing. They must justify the code.

MR. LEITCH: But even with that justification there would still be another cloud over that work.

DR. LANDRY: At this point there is in that we are very concerned about what is actually in the code now. This issue has been raised and we are flagged when anything comes in referring to this code, that indeed we must understand what is in the code first.

MR. LEITCH: I was just wondering if licensees might be spending a great deal of effort developing work in this regard only to find that it's unacceptable.

DR. LANDRY: At this point we are not aware of a number of our licensees using the code for a licensing application. There is one licensee that has submitted a reference to RETRAN-3D but that was to use RETRAN-3D in a RETRAN-02 mode as a substitute for the old version of RETRAN.

We have put very strict stipulations on how that can be done within the SER. Only one who has been approved for use of RETRAN-02 can use RETRAN-3D in a RETRAN-02 mode and then we specified what that entails.

The applicant in question is not a licensee who is approved for use of RETRAN-02. So that raises an issue in itself and we simply ask that licensee to demonstrate how they satisfy all conditions and

limitations stipulated in RETRAN-3D SER. When they get to the stipulation that they have to be approved for RETRAN-02 to begin with, they are going to run into a road block.

DR. BONACA: I had a question about what are the genetic implications of these findings to other codes such as RELAP-5, such as TRACK, that are being used now for best estimate calculations? I mean, do we expect to see the same kind of issues or problems there?

DR. LANDRY: In this discussion a number of issues have come up with the formulation of momentum that point back to work that was done back in 1974 and even before. The issues at that time that were brought up pertained to the formulation of momentum for the RELAP-3 and RELAP-4 codes which are the basis for RETRAN family codes which actually goes even further back. It goes back to FLASH. RELAP-3 came from FLASH.

This issue so far after looking at the other codes would not apply to the RELAP-5 and TRACK family because those codes started from a different derivation and different basis.

They drew on the work on RELAP-4 but the way in which they constituted the continuity equations was

different than was in the older versions of the RELAP. We have not gone back and checked exactly what's in there but the formulation is different for the newer versions of the codes.

DR. BONACA: I believe it would be appropriate at this time to look back into those codes and see if the same issues apply just because, I mean, clearly, I agree with you, there is a totally different formulation.

DR. LANDRY: We did raise that issue when we were doing the Siemens S-RELAP-5 review for an Appendix K application to small break LOCA. That question came up because of typos and other errors we found in the documentation.

One of the lead engineers that they now have at Siemens came in and gave a cogent, very good explanation of what is in the code and justification for the way momentum is formulated in the S-RELAP-5 which is going to be the same essentially as the RELAP-5 code.

Their explanation was far more justifiable and indicated that far greater support for the formulation of momentum that they have than we can point to at this point in the RETRAN codes.

We don't know absolutely that what is in the

RETRAN family is wrong. What we have in the documentation is not supportive of it.

DR. WALLIS: Apparently the code is based on the equations and equations have this strange way of resolving momentum fluxes which led to this pressure rise around the bend which seems, since you have the code, you could look at how they model bends they made in piping, loop seals and things.

We had a discussion with them which was inclusive of how they model the cold laid down comma transition which is a bend in there, we're looking at it, and they had some very strange terms in that one.

It is possible to look in the code and say what does the code actually have. You may be surprised. The code may have something else. But if the code reflects the documentation, then presumably these bends are doing the same sort of thing that the bend in the documentation was doing actually in the code.

DR. LANDRY: We would agree with you, Dr. Wallis, and that's why we've said that our recommendation to the applicant is that they explain what is in the code and justify it. Generally when a code of this nature is used, you don't actually model bends and calculate angles and change in flow

direction but you but nodes together with junctions where you have a farm lot.

DR. WALLIS: RETRAN makes a big thing about not having that. They actually have size and mysterious things which enable them to handle things like bends.

DR. LANDRY: We've asked for this to be explained.

DR. WALLIS: It would be very strange if they have in documentation all this new theory about bends and the code is still the old straight pipe junction.

MR. CARUSO: Dr. Wallis, this is Ralph Caruso from the Reactor Systems Branch. I think listening to all this discussion I would like to inject a little bit of, I'm going to say, brutal honesty here. We don't really believe there's a problem with the RETRAN code itself. We believe that the problem is the documentation.

The RETRAN-3D is a transition code. It's a new version of the RETRAN family and because the RETRAN community is trying to take the user community and bring it along to a new version of the code, they had to come out with something that they thought would be attractive to the existing users.

We believe that unfortunately in developing the documentation they attempted to describe it in terms which give it more credence than it necessarily deserves. They oversold it a bit.

DR. WALLIS: This is a strange statement. You mean the actual practice has no relationship to the theory?

MR. CARUSO: We believe that the way the code is set up -- as Ralph said, the problem is the documentation does not reflect what's in the code. The code and the documentation don't agree.

The documentation attempted to derive the momentum equations from first principles and show how they were applied in the code. Unfortunately, they are not applied that way.

DR. WALLIS: It almost implies that the ACRS should recode.

MR. CARUSO: Well, this goes back a little bit further to, I guess you could say, the strategy for doing this code review from the start.

We understood that the underlying structure of the code was essentially the same as RETRAN-02 and we made a conscious decision at that point that we were not going to review that underlying structure and those underlying equations.

The existing code, that structure, had been reviewed, had been approved, and has been in use for a large period of time and it generally seems to produce reasonable results that can be used by people to analyze the behavior of the plans.

DR. WALLIS: How long is this reasonable comparative time?

MR. CARUSO: Oh --

DR. WALLIS: Is it 20 years?

MR. CARUSO: Something on the order of 20 years. The documentation that's cited in RETRAN-3D is very much like the documentation. RETRAN-3D is 20 years old. It's an old report from INEL, I think. Is that what you're referring to?

DR. WALLIS: No. What I'm referring to is the documentation that you saw for RETRAN-3D as new documentation.

MR. CARUSO: It's very much the same as was in the 20-year-old document from Idaho. Same sort of treatments of bends and things there. It hasn't changed.

DR. BONACA: What concerns me is that there was a departure from RELAP-4 when RELAP-5 was developed. Unless the agency was totally wasteful with its money, it was done intently because it was

recognized that RELAP-4 was not capable of being a good prediction code. Is this correct?

I mean, that's the history of that time. That's why there was a departure. My concern is that whatever you do to patch up RETRAN, which is a derivation of RELAP-4, you may not be able to achieve what you want, achieve in a prediction fashion for the very reasons that led the whole industry and the agency to go to RELAP-5 to develop all new formulation of these equations.

My concern is that here we have -- I'm expressing this concern because this has been discussed with EPRI for 20 years, this attempt to bring RETRAN from RETRAN-1 to RETRAN-2 and now to RETRAN-3D. Next maybe RETRAN will do neutronics or who knows what.

I mean, is there something mentally wrong about attempting to take this code and make it do things it cannot possibly do? The reason why I say that question is that Professor Wallis brought up some fundamental issues there. I'm not sure that purely by changing somewhat the algorithm psi and putting some correction in terms will solve this issue.

DR. SHACK: Although I think it is true, what's unique about RETRAN is the introduction of the

psi angle and the attempt to apply a one-dimensional momentum equation to a 90 degree angle.

I think probably as long as the modeler avoids that option, it really does essentially adjunction the model. Those applications are probably okay.

What you worry about is the occasion when he actually tries to use that feature that he can take the momentum 90 degrees to the angle to which he thinks he's writing a one-dimensional equation. I suspect that is largely why the code works is that people by in large don't use that feature.

It kind of floats in there because, I mean, it's wrong. They fixed up one set of terms but they're not the worse because the cosine squared term isn't the problem. It's either zero or one so whether it's cosine or cosine squared doesn't make much difference. They have a missing cosine.

DR. BONACA: The problem with that --

DR. SHACK: It's zero and one.

DR. BONACA: The problem with that is this places the burden on the issuer and the issuer is not typically an expert in the code.

DR. SHACK: I agree that is a problem, why one set of codes is really different. I think that is

the unique feature of RETRAN is to introduce this notion that you can apply a one-dimensional momentum equation 90 degrees. That makes it different.

DR. BONACA: I knew that.

DR. SHACK: The reason it probably works much of the time is you don't try to do it too often.

MR. CARUSO: It is also important to understand that we know that this situation exist and the question was asked, well, how does this get fixed in the future? How do we know that someone doesn't make a mistake?

The staff process for approving the use of these codes has several steps. The first step we've just gone through is to improve the generic topical report but then each application has to be reviewed and approved specifically by the staff. We do ask for copies of the actual plant models as part of those approvals.

The staff will actually see the models that will be used by the RETRAN users when they want to apply them to their plants. Now that we are aware that this situation occurs, we can be alert to it and say, "Well, wait a minute. How are you modeling this 1-D momentum through 90 degrees in your plant model?"

DR. WALLIS: But you still have a problem.

Which psi will you accept? No psi is really right.

MR. CARUSO: Actually zero.

DR. WALLIS: No psi is really right.

MR. CARUSO: From our understanding of the way the RETRAN users actually use the code, they don't use that factor. They just put in form losses at the junctions.

DR. WALLIS: But they have to. You have to put in something for your momentum flux terms and something for your inertias terms. The L1s and L2s themselves, there is a question about how they fit in, too, when you go around a bend.

There are all of these questions about how this fundamental equation is used for various components. Are you going to examine every component in the reactor to see if they use the psi and which one did they use, if they used L1 or L2, and how did they choose it and all that.

MR. CARUSO: Actually, the EPRI people have also made a commitment to have the new users of RETRAN-3D submit their models to peer review panels so that there will be experienced users that look at the models that are developed to make sure they are not doing things in a too creative way.

DR. WALLIS: I guess there was a concern

that the consultants, particularly Novak Zuber, who has been around us for four years or so, if you don't go after some of these conceptual problems when you review the codes, errors get embedded and they go on for decades.

I don't know how you fix that but if you back off or if you say we'll fix it when it comes to a given utility using and so on, then this blemish stays there and will resurface again. You have to deal with it forever.

DR. LANDRY: That, I think, is one of the points that Ralph Caruso was referring to a moment ago that, yes, RETRAN-02 was reviewed and approved. The way we approached the RETRAN-3D review initially was we would look at the material that was new and different from RETRAN-02.

Rather than expend resources on reviewing the old code, we would only look at the new material. During the course of this review in all these discussions we've had, we found that we had to go back and look at the old material also.

This is part of the learning process we've been going through in these reviews in the past two years. Perhaps what seemed like the expedient thing for use of resources to only look at new material is

not the way we should approach the reviews.

We should be a little more sensitive to a code of this nature looking at the older material, the older version of the code also and take into consideration that perhaps there are things in the review of the old code that need to be re-reviewed as we move into the new version of the code.

That's quite different than when we receive a brand new code that we haven't reviewed because there we would want to look in detail at the entire code. This is a way we have approached reviews in the past. We have continued doing this code looking at only the new material.

Now we realize that perhaps that isn't the best way and that we do have to look at old material, too, so we don't perpetuate a problem from version to version simply because it's been grandfathered in.

MR. CARUSO: And to be honest with you, these problems exist in the plants. We have plants now that were licensed back in the '60s and the way they did things back then is not the way we would have them do them now.

When we have new license issues come in for those plants, we don't restart the entire review of the plant from ground zero. We make a conscious

decision to limit the scope of our review.

I understand the problem of grandfathering in decisions which seem to be a good idea at the time but which in 20 years hindsight may not be appropriate for current times. We don't have the resources to review everything from ground zero every time we have a change to it. We just can't do that.

DR. BONACA: But even for all the plants if you find a fundamental problem, you reopen the issue, right?

MR. CARUSO: The issue is what is a fundamental problem? In the case of RETRAN it does model the behavior of the plant reasonably well, well enough to make a decision. The question is is it doing for the right reason. Is it doing it for a technically defensible rigorously defensible reason or is it a simplification? How simplified can these equations be before they become undefensible?

DR. BONACA: But isn't a determination you have to make before you make a decision?

MR. CARUSO: But it's a judgment decision and right now what we've been going on is do the results look reasonable. Can somebody who is reasonably knowledgeable use this code to produce an analysis of the plant behavior.

Although there is a problem with the documentation, we believe that the code as used by those users still gives reasonable results.

DR. WALLIS: Maybe we've said enough at this time on this issue.

CHAIRMAN APOSTOLAKIS: Now, regarding the other issue you raised, which direction we want to go, maybe we ought to discuss this at another time after perhaps you give us some options based on your experience. You obviously have thought about it. It's always good to have a structured discussion, especially among 10 people to have some structure, some starting point. Would you be willing to do that?

DR. WALLIS: Do you think we would do it this Saturday if we're still here?

CHAIRMAN APOSTOLAKIS: We may start this Saturday because let's not forget we have huge task to complete at this meeting, namely the review of the research report. I'm not sure we will be ready by Saturday. Again, all I'm asking is two or three lines. It's not a major understanding.

Any other comments on this issue from any members?

Thank you very much, gentlemen.

We can proceed now with the chairman's

report on the South Texas Project Exemption Request.

It was a joint meeting of the plant operations and reliability and risk assessment subcommittees. Mr. Sieber, chairman of the plant operations subcommittee, will take the lead on this and I will jump in as necessary.

MR. SIEBER: Actually, since these 10 members were present for the joint subcommittee meeting, all this will be sort of a review as opposed to new material.

I guess I viewed this whole process from an operating standpoint as opposed to a PRA standpoint. The meeting that we had on the 21st involved the process, the element of categorization. We all got a packet of material on February 8 which most of my remarks are based on that packet of information.

My approach to doing these things is actually to first look at the plan itself and try to compare the numbers and logic that they use versus my memory of how these plants actually go together. I used the NRC database to look at the characteristics of the plant.

There are two units there. They are 4 loop PWRs. They are large united rated at 1250 MW electric. It's owned by Houston Power and Light.

It's about 80 miles from the city of Houston. It's a lake cooled plant and it does have some unusual features that affect its risk profile.

One is that it has three safety trains including three diesel generators which most plants have two safety trains. The safety trains starting from cold shutdown going up to the high pressure systems includes three RHR systems, three low-head safety injection systems, three intermediate head safety injection systems and what you would ordinarily think of as high-head safety injection there is actually charging pumps.

There are three of those even though from an accident standpoint I would discount one because it's a positive displacement pump 35 gallons a minute which I don't think help you much in an accident situation.

DR. POWERS: It's worse than that, Jack. It would probably hurt you in an accident situation.

MR. SIEBER: It's there and drawing power and doing nothing.

DR. POWERS: And it's putting the reactor into hot clad.

DR. UHRIG: Jack, am I correct in remembering that this is sort of a unique plant that has a longer core than the standard Westinghouse 4

loop plant? This is different than almost all other 4 loop plants?

MR. SIEBER: I think it's another foot longer.

DR. UHRIG: Yeah. Yeah.

MR. SIEBER: It has more elements, for example, by about 32 elements than a 3 loop plant which has about 157 elements in it.

DR. UHRIG: You know, the SNUPS design was the standard plant of that era.

MR. SIEBER: Right.

DR. UHRIG: I believe this one was supposed to be the next generation plant.

MR. SIEBER: Right. And it is lake cooled which is not unique in the United States. There are an awful lot of lake cooled plants. It has large dry containment.

Now, the exemption request itself, as I see it, it's purpose is to identify components that are important to safety from a risk standpoint and eliminate components not important to safety from the requirements of Title 10 CFR, Part 50, Appendix B and Special Treatment Requirements. I see 50 isn't on there.

The other thing is that it is also designed

to identify components which are risk significant but don't end up on the Q-list so that they can be added. This process actually goes both ways.

I tried to look at the number of components that they had. Of course, they listed their totals as for both units and specifically for 29 systems. A typical PWR might have anywhere from 50 to 60 systems, but there is no point in trying to categorize safety related or nonsafety, things like drinking water, building ventilation and so forth.

The ones that have some significance at all are the 29. If you look at this in a typical BWR, a single unit, it will have about 17,000 valves, another 17,000 circuit breakers or electrical components, motors and so forth, about 300 pumps and about six other heat exchangers, and a myriad of other things which for two units would be about 70,000 total components in the plant that are assigned mark numbers of one sort or another.

In the 29 systems there are 43,690 components in the two units. If you would look at their Q-list, those items falling under the requirements of Appendix B, there are 16,715 components listed there. These are the ones that are initially identified either by the nuclear steam

supply system vendor or the architect engineer for the interfacing systems.

CHAIRMAN APOSTOLAKIS: These are safety related?

MR. SIEBER: These are safety related components as originally determined when the plant was built.

CHAIRMAN APOSTOLAKIS: And there are no other safety related. This is it.

MR. SIEBER: This is it.

DR. WALLIS: This is the total for two units?

MR. SIEBER: That's total for two units.

DR. WALLIS: So 16,715 is an odd number. That means that something is gone?

MR. SIEBER: Yeah. For example, some systems are shared and some are not. I know of no two units regardless of how they were built that are identical.

DR. SHACK: The Inside NRC article on this made a comment that South Texas dumped more stuff on the Q-list than the typical plant does. They sort of hit this thing at the peak.

MR. SIEBER: Well, Appendix B come out in the early '70s and ours was one of the first plants to

have to adopt Appendix B after construction was underway and the design was done. Our Unit 1 had something like 4,000 or 5,000 items on the Q-list.

Unit 2, which was built a year before South Texas and went commercial, had the broad range and had about 7,000 items. There was a growth in what ended up on the Q-list of about, I would say, 35 percent over that time period.

DR. POWERS: I believe South Texas in the time it was in construction was one of those plants that benefitted from increased management attention.

MR. SIEBER: Don't we all.

Now, based on what I have learned, a typical PRA really covers about 2,400 components per unit. That leads to some interesting things. When you try to re-categorize all these items that are on the Q-list, you actually find out that you can only do that on the basis of PRA results for 5.7 percent of those items.

If you want to do the remainder, the only choice that you have is to do it by expert panel elicitation which amounts to 94.3 percent. I guess that makes my eyebrows go up a little bit when I think about the fact that categorization is "risk informed" based on PRAs. In my mind, less than 6 percent of the

items are based on the PRA. Everything else is based on the expert panel.

CHAIRMAN APOSTOLAKIS: No, but I think that is some additional elaboration that is required here.

MR. SIEBER: Okay.

CHAIRMAN APOSTOLAKIS: I don't think you mean that because it's not just the numbers. I mean, it's not the 5.7 percent of SSC in the PRA and the remaining 94.3 are not. The 5.7 percent are there because they are important to the CDF and LERF. I mean, there is a reason why they are there and the others are not.

MR. SIEBER: Well, you've got to go beyond that because the others may, one way or another, be implicitly a part of the ones that are specifically listed.

CHAIRMAN APOSTOLAKIS: Very good point. Yes.

MR. SIEBER: On the other hand, you can't go back and do a Fussel-Vesely or RAW for an item that's not there.

CHAIRMAN APOSTOLAKIS: Exactly. Exactly. I think, in other words, we should not be talking only in terms of the numbers. We should elaborate a little bit on that.

The other point is that, yes, it does appear that the remaining 94 percent are really categorized not using risk information but it was pointed out by the STP folks when they were here that the reason why they called it risk informed is because the whole context within which the characterization takes place is risk informed.

The fact that these are not in the PRA is already useful information to the panel because there is a reason why they are not in the PRA. You're right. I mean, it's not as formal as using the importance measures, for example, because you can't do it.

DR. POWERS: But, George, I think what he's saying is something more important there. There is not a case that there is a reason they are not in the PRA. There are two reasons, two general categories of reasons.

One, it's not important, and the other one is that it's implicitly present and the PRA analyst in order to simplify his model didn't call it out. I mean, that seems to me that's a very significant point.

MR. SIEBER: Well, and I think you have to go a step beyond that, too. When we get finally to

the explanation of how the expert panel does its business, there is actually risk information in the questions that they ask and the weighting factors.

In a way it's risk informed but as I still see it, it's less than 6 percent come directly from the PRA.

CHAIRMAN APOSTOLAKIS: It's not risk informed if you interpret risk informed using strictly numbers.

MR. SIEBER: That's right. These are the numbers here related as --

DR. BONACA: Just before you go past that, all that I've heard here is true. The only thing I want to point out is that there has been a focus on two measures of performance and if some other measures were used, probably some other components will have ended up there.

DR. KRESS: Yeah, I'm glad you said that.

CHAIRMAN APOSTOLAKIS: That's true. That's very true.

DR. BONACA: There is no doubt in my mind some of the components we probably question. For example, the assumption that since it is not an early release, you don't have to worry about it.

Therefore, you know, small failures of less

than one inch penetrations could affect later releases in containment and are not considered because that's not significant to the public. That includes the full characterization of penetrations.

DR. KRESS: And late releases in general.

DR. POWERS: It's also true that the crucial systems for shut-down operations aren't going to make this list here unless crucial equals well under normal operations.

DR. BONACA: You mean for intermediate targets?

CHAIRMAN APOSTOLAKIS: I think --

DR. BONACA: I am making this comment because I believe that there is an issue, at least in the generic fashion, for ranking we have to derive which is the issue of having a well-reflected on set of acceptance criteria. I mean, our CDF and LERF are the only criteria to use. I mean, we have discussed that.

CHAIRMAN APOSTOLAKIS: The question really is, I mean, it is a legitimate question in a sense but, on the other hand, you might say, "Well, gee, you guys have approved regulatory guide 1.174 and all this licensee does is follow 1.174 and that guide says LERF and CDF." Shall we raise the issue of what is risk

informed regulation every single time there is a case before us?

DR. KRESS: Yes.

CHAIRMAN APOSTOLAKIS: Then that throws the process --

DR. KRESS: We've approved a lot of regulations in the past that have proved to have flaws in them. I view this as a flaw of 1.174. You see, 1.174 was meant for very specific things. I think we've carried it well beyond what it was intended for when we try to make it a generalized way to risk inform the regulations.

CHAIRMAN APOSTOLAKIS: The next time the issue of revised or updating 1.174 comes up, I think this is a legitimate issue. Put yourself in the situation of a licensee. We have these new regulatory guides, they want to use them, and then the issue comes back and they say, "No. Look."

DR. KRESS: Put yourself in the place of the public and the concern of late releases and land and sees that NRC is not dealing with that.

DR. BONACA: But they have an expert panel, too. The expert panel makes judgments that remove components from a list and may even add them.

All I've got to say is to make this

statement that has been made, that you're going to have to consider late containment failure because by the time evacuation has taken place, it defeats everything we have done in this industry from day one which is simply you are not going to mess around with the public issues.

CHAIRMAN APOSTOLAKIS: And why when we look at license renewal we say the regulations dictate that we look at it in a deterministic way. All this stuff about risk and PRA over the last 25 years is not relevant, all of them.

Why don't we say, "Gee, if you've got that much frequency above the goal, maybe you ought to do something more." I would say no because the regulations say this. I mean, at some point you have to go by the rules.

DR. SHACK: In this case, George, we don't have a rule yet. Option 2 is trying to figure out how to do this.

CHAIRMAN APOSTOLAKIS: They are following 1.174.

DR. SHACK: Nothing says that has to be cast in concrete.

CHAIRMAN APOSTOLAKIS: I'm not saying it should be cast in concrete. The issue should be

raised but I don't think it's fatal because then nobody is going to try these things. They are going to say, "Wait for 10 years and until those guys in Rockville decide what's important.

DR. KRESS: I think all we're asking for is a question and an expert panel to look at it and say does this particular SSC impact light containment releases or late containment failure. If the answer is yes, you give it a weighting factor on the scale but you put that particular component in with the list that you have. I maintain it would probably only add about five or six. Maybe more than that but the question ought to be asked is my point.

DR. BONACA: And the point again, the latitude that the expert panel has is very large. Clearly, they --

DR. SHACK: They don't drop things. If the PRA says it doesn't get dropped --

DR. BONACA: If a system is rated significant but has multiple trains to support it, they are calling them, for example, a lower significance because they have it on their system. Now, they are taking quite a latitude.

CHAIRMAN APOSTOLAKIS: That's the same issue.

DR. BONACA: No, no, it's not the same issue. I'm saying that the expert panel has a significant decision making they have established and I support it. I can question the decision but I agree that they have the capability.

I think they should also reverse capability. I think that the issue with these guys here is one that looking at the generic process we would have to reflect on and understand.

CHAIRMAN APOSTOLAKIS: I'm having problems with 1.174 myself. I think when we make comments like this, we should be aware of the other guy's problems. If we throw 1.174 out the window --

DR. KRESS: 1.174 has a statement in it that in addition to the CDF and LERF you will comply with all the deterministic requirement. Those deterministic requirements deal with things like late containment failure releases.

Here we have an exemption that says we don't have to do light containment because it doesn't affect CDF or LERF, but it is in all these other deterministic requirements that you are supposed to comply with.

CHAIRMAN APOSTOLAKIS: Well, if you put it that way, I think it's a more legitimate concern in my

view because you're doing it in the context of an approved guide.

DR. KRESS: I think that was the reason they left that kind of statement in the 1.174 is to recognize it wasn't just CDF and LERF.

CHAIRMAN APOSTOLAKIS: In that context, though, I mean, when you talk about these kinds of things, the question is whether you should limit yourself to these big items like core damage and releases from containment.

A lot of these other requirements are there to really address the cornerstones of the oversight process. I mean, we don't want to see initiating events. We don't want the integrity of the primary look to be compromised.

A lot of the requirements are there to make sure that these cornerstones are satisfied. Now if we come in with a risk approach that says we are going to look at CDF and LERF and late containment failures, are we consistent?

I don't think we are because there may be some requirements there, you know, the staff has made it very clear we just don't want to see initiated even though they may not progress to something very severe.

DR. BONACA: The issue of late containment

failure, I don't think they use the PRA for that. They use some of PRA regarding the fact that the highest risk is LERF.

MR. SIEBER: When you look and see how they classify based on RAW and Fussel-Vesely, that is really CDF and LERF without those extended effects. I could do it but I don't think as I read the methodology that they have done it.

CHAIRMAN APOSTOLAKIS: Do you think, though, that if there was an issue regarding one particular component that came from the PRA or from the questions that it was really in risk 2, category 2, and it was important to late containment failures, do you think the panel would not be aware of that and perhaps move it to something else?

DR. KRESS: From what I read in the report, yes.

CHAIRMAN APOSTOLAKIS: Which may be a matter of documentation again, the same as it was with the other thing. If you put it in writing, then the staff will stop asking questions about that.

DR. KRESS: All I have to go on is what I have in writing.

CHAIRMAN APOSTOLAKIS: I know.

DR. BONACA: They ask questions. We ask

questions and the answer was because it's a small leakage so it is minor and there will be no impact.

I mean, it really undermines somewhat my faith in that expert panel because although you may rationalize that, dealing with issues that have to do with the last barrier of the tail end of a major accident is something that is totally new in this environment.

DR. KRESS: And their statement, George, that large early releases prompt fatalities dominate the risk to me is an unproven assumption. When I say that, what they mean is if you meet that goal, you will also meet the latent fatality goal but it says nothing about land contamination, total injuries, total deaths. I don't know whether it dominates the risk because we do not have appropriate risk metrics for these other things to compare it with.

CHAIRMAN APOSTOLAKIS: But, Tom, we proposed to the commission to do that and they said no.

DR. KRESS: I know, but I'm a persistent son of a gun.

CHAIRMAN APOSTOLAKIS: There has to be --

DR. BONACA: All that we have to do is say this stays in the list because they are significant and they could affect releases. The whole issue of

performance measures from PRA would be moot if they had made the call. They didn't. That's why I'm questioning the call.

I'm not questioning the structure of the regulation. I'm questioning the call. Maybe then on a generic basis if those calls can be made, then there has to be a need for more structured guidance.

CHAIRMAN APOSTOLAKIS: But it's pretty clear, to me anyway, that when you consider affects that go beyond CDF and LERF, that the expert panel probably wouldn't know how that component actually affected the late release or land contamination or injuries, I think it's beyond what information the expert panel would ever have.

CHAIRMAN APOSTOLAKIS: But in terms of the cornerstones, though, I think the expert panel will be very much informed. In other words, you know, on an initiating event that's something that is within the experience of people.

MR. SIEBER: Does the staff have a comment?

MR. NAKOSKI: This is John Nakoski. I'm the project manager overseeing South Texas. I would just like to remind the ACRS members that the staff shares a concern regarding late containment failure. We have an open item with South Texas on this issue. We have

asked them to evaluate their categorization process and consider methods to address that.

One of the alternatives we suggested they do was to look at their PRA specifically for conditional containment failure probability with doing a sensitivity study where they increase the failure rates of those components important to protecting the containment by a factor of 10, similar to what was done for the broader sensitivity study.

For each component really, or system, come up with an evaluation that says why it's not necessary to protect a containment. We share the concern that's being expressed here and we are working with the licensee.

CHAIRMAN APOSTOLAKIS: Why only the containment? Why not the other cornerstones? I thought the whole idea of special treatment was to make sure that this totality of the deterministic regulations protect us from public unhappiness. It's not just health and safety. It depends upon how you interpret health.

DR. KRESS: What this process will do, George, is -- what this process will do is focus on only risk dominant sequences when they do what they talked about.

If you look at conditional containment failure probability, I think that's probably an appropriate way to deal with this late containment issue because you dealt with the other phase on your CDF.

CHAIRMAN APOSTOLAKIS: I'm not clear. CDF is in full sequence. I mean, now the initiating event itself is something we don't want.

DR. KRESS: Yeah, but it gets involved in the CDF and they've dealt with it to some extent.

CHAIRMAN APOSTOLAKIS: In some sense but it doesn't get the same importance.

DR. KRESS: Perhaps. Perhaps.

CHAIRMAN APOSTOLAKIS: The objectives, it seems to me, have not really been settled.

DR. KRESS: But, you know, if the thing is not important to CDF and SSC, then it's likely not real important to the initiating event frequency.

CHAIRMAN APOSTOLAKIS: No, because you may have an initiating event that has been mitigated with very high probability.

DR. KRESS: Of course.

CHAIRMAN APOSTOLAKIS: I think we are going to come back to these things. Right?

DR. KRESS: Right.

DR. WALLIS: I had a question about that. You have 5.7 percent in the PRAs but 8.78 percent turn out to be safety risk significant. Presumably the expert panel added quite a few.

MR. SIEBER: Right.

DR. WALLIS: I just wonder about the overlap. Are there perhaps things that the expert panel considers which are really more important than are in the PRA? There's an overlap there.

MR. SIEBER: I think there are some things in the PRA that are of low risk significance.

DR. WALLIS: So you might argue that --

MR. SIEBER: So not all 2,400 items that were in the combined PRAs for those units necessarily made it to the --

DR. WALLIS: I was just telling you something about completeness of the PRA. The expert panel adds things which really are more significant than some of the things in the PRA. Perhaps those things should have been in the PRA in the first place.

MR. SIEBER: When we get to the classifications scheme that the expert panel used, you can see how, for example, some components would have ended up being risk significant as far as their scheme is concerned and not necessarily been in the PRA when

we get to that.

DR. WALLIS: Maybe you could address that later.

CHAIRMAN APOSTOLAKIS: The panel used criteria out of CDF and LERF. They actually did.

DR. KRESS: If PRAs were complete and dealt with uncertainties and dealt with all the modes of operation such as shutdown or low power, then you would expect PRA to kick out all the important things.

CHAIRMAN APOSTOLAKIS: That's right. On the other hand --

DR. KRESS: It's not complete and there are parts that are highly uncertain, then it doesn't deal internally with shutdown and other things it doesn't deal with very well so, you know, you would expect other questions to be asked.

CHAIRMAN APOSTOLAKIS: It's not just incompleteness. It's also --

MR. SIEBER: You could not write a PRA that covered all of these components in my opinion. I mean, that would be lifetimes worth of work to try to model all of these subcomponents.

DR. POWERS: I'd like to point out that a lot of people are making PRA their lifetime's work.

MR. SIEBER: I understand that.

The reason for me putting this slide up is just to show that there's two different methods of arriving at determination of risk significance. As Dr. Shack pointed out, these are additive. You go through the PRA portion of it to cover the 2,400 components. Then the expert panel does the remainder.

Interestingly enough, they also use the expert panel as a way to check by doing some of the PRA components also. It turns out that there was some consistency there between when they were evaluated both ways. One way by PRA and the other way by the expert panel. I would like to talk about the PRA components first and then the expert panel components next.

From the PRA results, classification for the ranking that they got was high, medium-R, which means that they want to consider it as high so that sometime in the future if it became reclassified as high, they wouldn't be stuck without documentation, without adequate maintenance, without inspections and surveillance, and all the other things that Appendix B requires because these things can shift as the plant is modified. There is additional operating experience as far as failure rates and so forth are concerned.

Then medium and then lastly low. These are

all based on risk achievement worth and Fussel-Vesely criteria. That is one of the reasons why the PRA subcommittee was a part of this to assist to the plant operations subcommittee.

It's not clear in my mind. These look a little arbitrary to me. It's not clear in my mind if these are the right numbers and the right criteria or not. Perhaps I could ask for comments on that from anyone who feels --

DR. KRESS: Associated with that question is if the RAW is 99 --

MR. SIEBER: Right. What do you do?

DR. KRESS: -- take it down to the medium where the other things are met.

MR. SIEBER: That's where the expert panel comes in again. We shouldn't take these as rigid boundaries and so on. I mean, the expert panel does evaluate the results of this, too.

I think the whole approach here should be to put things in context. There is a decision that is made by the panel. In order to make that decision, they collect information from analysis. One is the PRA with these kinds of things, the high, medium, and so on.

They collect information from the five

questions that Jack will talk about in a little bit, the rates and so on, doing it different ways. They can decide looking at the individual categories and then they deliberate. This is really a structured deliberation. In that context if RAW is 99 is irrelevant because they will look at it and they will not say, no, it's not high because it's 99 and the boundary was 100. The other thing is --

CHAIRMAN APOSTOLAKIS: What would they do with 90?

MR. SIEBER: Well, they have to make a judgment.

DR. SHACK: Once you've made the decision, you do have to check with the sensitivity study. I claim that's the real decision.

CHAIRMAN APOSTOLAKIS: Exactly.

DR. SHACK: This is the way to select a group of components to examine that way. If you can't meet the sensitivity study, then you have to go back and you'll throw out components that hit 90. You'll have to go back and keep throwing stuff out until you can get through the sensitivity analysis.

DR. KRESS: RAW is the sensitivity study.

CHAIRMAN APOSTOLAKIS: Yeah, but the big one at the end where they increase the federal rates by

10.

MR. SIEBER: I have some questions about that, too, which maybe I would like to address. First of all, this classification puts things on the list. On the other hand, when the expert panel did evaluate components, they evaluated not only the ones that didn't show up in the PRA but also ones that did.

It could end up on this new Q-list more than one way. It could end up there because of the PRA and this classification scheme, or it could have ended up there because of the expert panel which is independent but serves as a check, one against the other.

CHAIRMAN APOSTOLAKIS: No, but this was input to the panel. There was no categorization independently of the panel.

MR. SIEBER: That's right.

CHAIRMAN APOSTOLAKIS: The panel has the final word so this goes to the panel for evaluation.

MR. SIEBER: Right.

CHAIRMAN APOSTOLAKIS: Jack asked where the numbers come from. It's really experience and sensitivity.

DR. KRESS: Let me ask you a question. I would expect that the value of, say, RAW or Fussel-Vesely that's important would depend on absolute value

in the CDF and LERF. It doesn't show what they want. Why doesn't it?

CHAIRMAN APOSTOLAKIS: It's relative. That's one of the problems with these things, that whether you are at the 10 to the -3 CDF.

DR. KRESS: I understand that. I'm saying that the cutoff, the threshold ought to depend on the absolute value and I don't see that reflected.

CHAIRMAN APOSTOLAKIS: It was in the paper by Geoak, Perry, and Sherry that these numbers and the actual delta CDF don't relate. Why should you have the same cutoff value for all plants?

DR. KRESS: If I had a CDF 10 to the -6, why would I worry about the RAW and the 100.

CHAIRMAN APOSTOLAKIS: Because it can still make it 10 to -4 which is still acceptable.

DR. KRESS: That's why I think I worry. These might be plant specific values and I worry about getting them locked into a system for every plant that we review. I might not like those numbers for some plants but I might like them very well for, say, South Texas.

CHAIRMAN APOSTOLAKIS: I still think we have to have things in perspective here. I don't think that any single method they use can withstand the kind

of scrutiny we are giving it here. We expressed a lot of concerns last time at the subcommittee meeting.

Let's see what we're trying to do here. Again, this is structured deliberation. The panel puts them in categories. Then you have two major things that I think save the day. One is the sensitivity.

They say, "Okay. Forget about all these things. We made mistakes. Let's raise all the failure rates by 10 and see what happens." Then they find that nothing much happens. That's a very powerful argument.

DR. POWERS: I wonder how powerful it is, though. The challenge you always have with these things is they are one at a time kind of variation and they are not really partial derivatives.

You tell me that you've raised all these numbers by a factor of 10 it's a little difficult for me to put that into perspective. Has anyone ever taken one of these assessments for any plant, I don't care which one, and looked at partial derivatives and second partial derivatives?

CHAIRMAN APOSTOLAKIS: No. This is a very new idea.

DR. POWERS: Why not? Why shouldn't

somebody do that?

CHAIRMAN APOSTOLAKIS: Because they haven't thought about it. Nobody's thought about it.

DR. POWERS: You see, it all boils down to the question of where did the factor of 10 -- I mean, factor of 10 sounds big but it's not really big. I mean, we're working in long space here.

CHAIRMAN APOSTOLAKIS: That's my point. The sensitivity study is one. The second, let's not forget what the decision is here. It seems to me you are relaxing some of the special treatment requirements. What's going to happen?

If you have an impact at all, it's going to be gradual. You're not going to have a catastrophic failure tomorrow to 15 components and they will have a monitoring problem.

DR. KRESS: In reality what you're saying is special treatment requirements are not very risk significant in the first place.

CHAIRMAN APOSTOLAKIS: That's exactly right.

DR. KRESS: That's a saving grace made for here.

CHAIRMAN APOSTOLAKIS: Exactly. That's my point.

DR. KRESS: But that's an assumption,

George.

DR. SHACK: No. If you pick a different set of components and change the failure rate, you get a very different answer. This factor can only work because you're doing it to a selected set of components.

CHAIRMAN APOSTOLAKIS: That's correct. But there are several issues here. First of all, to save that relaxing the requirements will lead to an increase in factor of 10 is ridiculous. It's utterly ridiculous.

Second, you are increasing the failure rate, not the event itself. It's not going to happen tomorrow. You're not going to have a huge common cause failure where all sorts of things fail. I mean, if these things happen, they will catch them. They will have a monitoring program.

DR. SHACK: But, George --

MR. SIEBER: This is one of the elements of this classification scheme, the feedback system, which comes from the corrective action program. On the other hand, I guess when I thought about this, I think of different kinds of plants with different risk profiles and how this sensitivity study would reflect itself in those plants.

For example, the South Texas project has a pretty good risk profile and it comes about because of the three safety trains. When you increase a competence failure rate by a factor of 10, is it really going to show up as being significant in the profile for that plant?

I would think it would not be as significant because of the redundancy that is already built into that plant with the three trains. But if you had two trains, it may be more significant. For a different plant, you may reach a different conclusion.

The other kind of plant that I consider is there are some plants that have relatively high but acceptable risk profiles and are dominated by a particular sequence.

If you change the failure rate of a component not involved in that sequence, it gets swamped out by the dominate sequence so you may not be able to draw a conclusion from that either. I think sensitivity works better for some plants than for other plants.

DR. KRESS: I'll tell you what bothers me about the whole process is I have this intuitive feeling, like George said, that this is not very risk significant, but my intuition has been wrong a lot.

I don't see a coherence to this process where you start from the top level.

Our objective is to meet these regulatory limits on certain things. They are going to be things like containment failure, total deaths, maybe CDF. I'm not even sure I would include that. Most people would but we want to achieve certain frequencies which you exceed land contamination. Those are all regulatory objectives. Those are what we're trying to achieve by the systems and components we have in the design.

I don't see starting from those things we're trying to achieve looking at how the plant already meets those, and determining how each system and component affects that and whether or not if I put one in one category or another, whether or not I step over the balance or get too close to the balance depending on the uncertainty.

That coherence is just not there for me and that's what bothers me. It just doesn't hold together because, you know, you look at this and I don't know why RAW of 100 is a good number for this plant. Why is it a good number?

DR. SHACK: This is just a preliminary screening value. There is a misplaced precision here.

We're talking about numbers that just don't have that kind of exactitude.

DR. WALLIS: I think they should have some justification.

DR. SHACK: What you really look at is you get to these numbers and do you get a change in CDF and LERF that is significant by the standards of 1.174. It may well be that for other plants when you go through that final assessment you'll have to use different numbers. Maybe you could have changed these numbers and still met that assessment in South Texas.

DR. KRESS: That's the part that's missing.

DR. SHACK: No. That's the consistency part.

DR. KRESS: It doesn't say how these numbers were derived from the 1.174 requirements.

DR. SHACK: The question is is it good enough that when you use these numbers, you meet the 1.174 requirements?

DR. KRESS: I don't know. That's the part that's missing.

DR. SHACK: No. They do. That's what they check at the end. They mask their categorization. Then they do their sensitivity analysis to make sure they meet the 1.174 requirements. Could they have set

the numbers at 110 and still met it? Maybe. Could they set them at 90 and still met it?

DR. WALLIS: Maybe for some plants it should be 1,000 or 10 or something. Maybe it's really different for some plants.

DR. SHACK: The answer is as Jack said, you'll get different answers for different plants. Maybe if you use these numbers and you go to a plant with two trains, when you make the sensitivity analysis you'll find out that you don't meet the 1.174 requirements. You'll have to come back and change these values. You'll have to be more restrictive.

MR. SIEBER: In fact, I see this as an interactive process. If you applied this methodology from one plant to another, you would have to go to the end, do the sensitivity analysis to determine whether you picked the right numbers in the first place.

As Dr. Apostolakis said, it's basically experience. I don't have enough experience to say whether 100 or 110 or 90 is the right number for the upper boundary. On the other hand, the proof of the pudding comes from the sensitivity analysis as long as you understand what that really means because different plants are going to respond in different ways to the outcomes of that analysis in my opinion.

DR. KRESS: So we're being asked to believe that a sensitivity of 10 varying one component at a time --

DR. SHACK: No, no. All together.

DR. KRESS: All together.

DR. SHACK: All together. They raise them all by a factor of 10 all at once. It's not one at a time. Bang, all the non-risk significant components go up by a factor of 10 all together. To do what you want to do, you would really have to know how the special treatment affects the failure.

DR. KRESS: Which I agree is impossible.

DR. SHACK: If we want to stay here until hell freezes over, we can do it.

MR. SIEBER: There is a more subtle question buried in that. If you maintain surveillance and have a good corrective action program and so forth, it probably doesn't change the failure rate very much.

When I think about it where you don't have diversity, you may change the common cause failure rate which I think is perhaps more significant than a single failure or an increased probability of single failure. That's my intuitive feeling as opposed to any proof that that would occur.

It seems to me if you eliminate certain

portions of a consideration for a group of identical components, if they're going to fail, they're all going to fail in that mode sooner or later. So that may have a barring on it. On the other hand, their treatment of common cause appears to be conservative in the way they have approached it.

In any event, this is the --

MR. SIEBER: There's a typo in there somewhere. It cannot be .001 on the top because the Fussel-Vesely of .002 and a RAW of 1 would be both high and low at the same time.

DR. WALLIS: There probably is and I'll look that up and tell you what it is.

MR. NAKOSKI: This is John Nakoski again. It is on the high value Fussel-Vesely greater than equal to 0.01.

DR. WALLIS: There are too many zeros.

MR. SIEBER: Okay.

Well, this takes care of the 5.7 percent. Let's take a quick look at what the expert panel does with the 94.3 percent. They ask five critical questions and they rank each component by the component's sensitivity to frequency of occurrence, which is demand, and/or the perceived risk impact. Let's take a look at the five questions.

These are evaluated basically two different ways. These are the questions that they chose to ask. I guess one of the observations one could make is that there is some overlap from one question to another. It's not totally clear as to how great the answer is. On the other hand, these seem to be reasonable questions in my own mind to ask for the purpose of categorization.

Does the loss of this function cause an initiating event?

Does the loss of this function directly fail another risk significant system?

Is the function used to mitigate accidents or transients?

Is this function directly called out in EOPs and ERPs?

Does this function directly affect safe shutdown or mode changes?

Now, they have assigned a specific weight to each of these questions. If you want to make notes, "Does the loss of this function cause an initiating event?" is weighted as three which seems to me a little odd but that's the way they weight it.

"Does the loss of this function directly fail another risk significant system?" is weighted as

four.

"Is the function used to mitigate accidents or transients?" is weighted as five or most important.

"Is this function directly called out in EOPs and ERPs?" is also weighted as five. At least for the confidence of the operator, it would be nice if he knew that everything that was in the EOPs or the ERPs was operable and would work.

"Does this function directly affect safe shutdown or mode changes?" is rated as a three.

Now, for each of the questions the component is rated basically two ways. One is what is the demand and what is the risk significance in the component.

Then it is weighted by a scale of one through five with five being the most risk significant. You multiply the five times five points for the question itself times by the weighting factor which is five and you end up with a maximum 25 or a minimum of five.

DR. WALLIS: So if they weighted them one, two, three it would have been just the same.

MR. SIEBER: Well, they --

DR. WALLIS: They all got three for writing their name on the paper.

MR. SIEBER: That's right.

DR. UHRIG: Jack, this isn't as a yes, no, zero, one which is then multiplied by three and then multiplied by five?

MR. SIEBER: No. Actually, the --

DR. UHRIG: The question is is it or is it not.

MR. SIEBER: The expert panel is actually instructed by their procedure to rank. Okay? And that's on the basis of frequency of occurrence or demands and risk significance. Is that not correct? It's not a zero one proposition.

For example, and let's go back, if I asked the question, "Is the function used to mitigate accidents or transients." When the demand is high and the risk significance is high, I would rank it as five. Five times the weighting factor of five is 25 so you get 25 points. Okay?

On the other hand, does the function directly affect safe shutdown or mode changes, the weighting factor is three. Even though it may be important and risk significant, the total score of five times three is 15. Okay?

DR. WALLIS: Who fills this out? Does the STP fill this out or does the expert panel fill this

out?

MR. SIEBER: The expert panel who is employed by STP.

DR. WALLIS: They have to answer all their own questions?

MR. SIEBER: That's right. You end up, by the way, as part of the process a different feudalist than the original one which is part of the submittal.

DR. WALLIS: So they have to do all the work of finding out if this function is called out in EOPs and all that?

MR. SIEBER: That's right. It's pretty easy to do. The EOPs are on the computer and all the mark numbers are in there. All they have to do is a word search and out comes all this --

DR. WALLIS: Yeah, but if it's a kind of secretarial job, we really don't need to have an expert panel do it.

MR. SIEBER: No. The clerical function of arranging all this I'm sure is done by clerks. The panel actually has a pretty demanding qualification requirement as I see it.

MR. LEITCH: Jack, are there two answers, one based on frequency and the other based on perceived risk impact or are they somehow merged

together?

MR. SIEBER: They are merged together so that you end up with a single number. These are the risk impact and the frequency and this is the way it's phrased. If you look in your package, there would have been -- you weren't there but there is a document called "ACRS Backup."

If you look at that, and these pages aren't numbered, but about halfway through where it says "weighting scale," it explains how the questions are asked, how the match is done, and how the scores are determined. They are actually determined two different ways. One of them is you determine the total score based on all the questions.

As it turns out, the combination of two fives, a four, and two threes when multiplied by five equals 100. That's where the weighting factors actually came from as opposed to getting 25 points for putting your name on the paper.

So then they look at the ranges in which these answers came out and they said if it's between 71 and 100 it's high-risk significance. If it's between 41 and 70 it's medium-risk significance. If it's 21 to 40, it is low-risk significance. Zero to 20, it is not risk significant at all.

This is one of two methods that they use to categorize. The other method actually looks at the answers to individual questions. If you get an answer for an individual question with this weighting factor that is greater than 20, then any one question automatically high-risk significance.

If it's between 12 and 20 it's medium-risk significance. If it's between six and 12 for any single question, it's low-risk significance. If it's below six, it's not risk significant at all.

These are additives. You can either achieve the score this way or the answer to a single question could put it into a category, the components up in the highest category of whatever method is used.

Now, I have to ask myself a few questions when I think about this whole process. The question that come to my mind is when we just stick with CDF and LERF, which to me is implied when you use RAW and Fussel-Vesely, are these -- that's not true?

DR. KRESS: No. You can do a RAW or Fussel-Vesely on anything.

MR. SIEBER: Okay.

DR. KRESS: But the RAW and Fussel-Vesely they use were for --

MR. SIEBER: For CDF and LERF. Well, the

question is are these the right criteria and are they the only criteria that should be used which, in fact, CDF and LERF --

DR. WALLIS: Let's go back to what's happening here. There's the PRA results which form one package. Then there's the 94 or 96 percent.

MR. SIEBER: Right. Another box.

DR. WALLIS: This is the other box.

MR. SIEBER: And they overlap.

DR. WALLIS: The experts don't evaluate the stuff that's in the PRA using their matrix?

MR. SIEBER: Yes, they did.

DR. WALLIS: Ah, so you can compare one versus the other.

MR. SIEBER: In fact, that's one of the checks used during the process.

DR. WALLIS: Okay.

MR. SIEBER: That's one of the checks.

DR. SHACK: That's how you decided that the binning was reasonable.

DR. WALLIS: Is there some evaluation of the reasonableness of the binning when you look at this comparison?

MR. SIEBER: Yes.

DR. WALLIS: Okay.

MR. SIEBER: And to me that's one of the key saving graces of this process, at least from the standpoint of what the staff has to deduce out of the process to say, "Yeah, this is reasonable." Or, "No, it is not." That is one of them. The sensitivity studies is another one. To me I think it's pretty important that they did that overlap and came up with a reasonably consistent answer because that tells you something about the effectiveness of the panel.

DR. SHACK: I seem to recall numbers like PRA gave me 800 and the expert panel on the same set of components gave me 840 so they were somewhat more conservative which you would sort of expect.

MR. SIEBER: Okay. The next question that I asked in my own mind, which we have discussed at length here, is are RAW and Fussel-Vesely the correct measures of importance of the component in this context and also the numbers.

DR. WALLIS: You shouldn't use the term correct. You say appropriate or something.

MR. SIEBER: Appropriate.

DR. WALLIS: Correct implies some sort of absolute standard which is the reason for these things.

MR. SIEBER: That's right. Okay. And the

third question, I think, that I asked of myself, which I came away with based on the outcome of the comparisons as being okay, is do these deterministic questions and the weighting factors make sense.

I guess you can ask any questions that are pertinent to risk and assign any weighting factors. The proof of the pudding is when you compare that to the PRA studies, do you end up with consistency? The answer is yes. These are reasonable questions to ask except, in my opinion, there is some overlap associated with them.

I scratch my head. For example, does a failure of this component create an initiating event, and they weighted it only as three. I thought, gee, if you don't have any initiating events, your risk goes way down. It wasn't clear to me why that was the case.

On the other hand, there's a lot of initiating events that don't proceed beyond the fact that the plant shuts down safely and 9,999 out of 10,000 is probably the right number for that because we've only had in commercial plants one accident.

DR. BONACA: You are close to the end, right?

MR. SIEBER: Yes, I am. We'll move rapidly

to the end. I just have two more slides to do.

The process of doing this comes up with a two-by-two matrix which looks at safety related and risk significant components, non-safety related but risk significant which covers the two categories that I listed first as the purpose, and then safety related non-risk significant and non-safety related non-risk significant.

Of course, they end up with 8.7 percent as compared to 5.7 which is one way or another identified by the PRA as being important. There is some overlap so the expert panel actually added approximately 1,200 components to the process. Non-safety related and risk significant, 372.

Now, the question here is these were not on the original Q-list but it turns out that they are important from a safety and risk standpoint. So the question is do we now have a safety question that perhaps STP has answered by using this process.

But maybe there are other plants out there that have similar original classifications schemes where they haven't gone through this process and perhaps there are components in other plants that have more risk significance than is reflected in the application of Appendix B. To me, that's a site

benefit to STP but a question for the staff to think about in the process.

Safety related and non-risk significant is 12,905 which would be the items where special treatment requirements could be relaxed to one extent or the other. And non-risk significant and non-safety significant is all the remainder of the components in the 29 safety systems that were analyzed.

DR. POWERS: Jack, I never understood exactly why in the safety related non-risk significant category we don't just treat them the same as the non-safety related, non-risk significant. I relax it down to industrial use or whatever it is that you specify for --

MR. SIEBER: I think that when you go back to the slide, and I may not be able to remember it, but there was four classifications from high, medium or --

DR. POWERS: I understand that.

MR. SIEBER: So in some cases components, the application of special treatments, was not fully relaxed so that in the event that --

DR. POWERS: I know what they've done. What I don't understand is why they've done it.

MR. SIEBER: Why they did it the way they

did? I think it is a conservative approach in my opinion.

MR. NAKOSKI: This is John Nakoski if I could address Dr. Powers' question. In option 2 one of the restrictions that we have is that we need to maintain a design basis of the plant, which is what the plant was licensed to.

Completely relaxing all the controls without having any confidence that these components would be able to perform their functions would essentially be a change in the design basis which would be a change in the licensing basis which is not where we wanted to be in option 2. That's the short answer, sir.

DR. POWERS: See, I come from the viewpoint for these non-safety related non-risk significant items when they acquire them, they basically acquire things that actually work and do their job so your confidence here, if you did the same thing for these things in the lower left-hand corner, it's not that you would have zero confidence. You would not have maybe as much as you would for the upper left-hand corner but it's not zero.

I think there's a nice term or phrase for industry practice or something like that for the kind of confidence you have. It just strikes me as

timidity for the reason of being timid. That's what it strikes me as.

MR. SIEBER: I think the kinds of things that are relaxed are some of the pedigree requirements. Is that not the case?

DR. POWERS: Sure.

MR. SIEBER: You buy a valve and the valve cost you $1,000, but the bill you get is $10,000 and the paper that you get weights three times as much as the valve.

DR. POWERS: It should because --

MR. SIEBER: You have to ask yourself how is that used for safety?

DR. POWERS: It's nine times more expensive. I mean, the paper is nine times as expensive as the valve so it should weigh more.

MR. SIEBER: That's right.

DR. POWERS: It's a trouble I have with option 2 to begin with.

MR. SIEBER: I think what you're telling us is it's as much a legal requirement as anything else.

MR. NAKOSKI: Specifically for South Texas and the exemption space, yes. In rule making there may be other alternatives.

MR. SIEBER: Now, just to finish up here, on

February 8 we got a package which listed basically open items. I think there were 18 open items -- or 22. In any event, when we actually had the subcommittee meeting, we only talked about three open items.

The difference is because at the subcommittee meeting we are only talking about the categorization process. The list that we had on February 8 included all open items on the option 2 process. A lot of those have gone away.

Let's see. Actually, on that list there were 16, four of which were closed, one of which was confirmatory, one which is before the risk informed licensing panel for some kind of a confirmation or final resolution or approval, and seven still remain open for the whole process. Is that correct?

MR. NAKOSKI: I can give you some more updated information. We met with South Texas on February 15 and 16. There were currently five open items that were closed without exception based on the licensee's response.

Three open items that with some editorial changes that were agreed to during the meeting would be closed. Six have some level of success path identified and agreed to into varying levels of detail

and agreement.

Three require, I think, further interactions between the licensee and the staff and those deal primarily with the seismic and environmental qualification issues. There is one on controlling changes to the processes that the staff has not yet finalized its position on.

MR. SIEBER: Okay. Thank you.

That concludes the presentation if anybody has any comments. This is where we stand at this point. I was sort of under the impression that what we ought to do is wait until the process is completed before we write a letter but we may want to reconsider that because, I guess, in my opinion this is a pretty complex subject and to leave everything until the end might cause a setback from the staff's standpoint on their timely resolution of things. That's something we have to decide this week.

DR. BONACA: What are the thoughts of the staff regarding the report at this time?

MR. NAKOSKI: I think your insights on categorization at this time would be valuable for us to move forward recognizing that you haven't gotten any substantial feedback on where we are with treatment. I think there would be value added now to

get this behind us.

MR. LEITCH: I have one question regarding weighting. If I understand correctly, zero to 20 they call non-risk significant.

MR. SIEBER: That's right.

MR. LEITCH: That would then put it in the lower left-hand box, safety related.

MR. SIEBER: If it was on the Q-list and it was zero to 20 and confirmed by the expert panel as belonging there, it would be in the lower left-hand corner.

MR. LEITCH: I can understand how it would get to the very low risk-significant but not non-risk significant. In other words, if you ask these questions, say is the function used to mitigate accidents or transients, and even if it's a three as far as risk, I tend to get a 15.

MR. SIEBER: I think what happens is a lot of times in the original classification of what belongs on the Q-list and what does not, they would take it either as functions or systems.

There are things in a system that might require some pedigree because it originally fell under the requirements of Appendix B who really doesn't serve any function whatsoever as far as accident

mitigation.

It's not called out in the EOPs. It can't cause an initiating event. It's just there. It's in that system because of the way it was classified the first time around. I suspect there are a fair number of items that are like that.

MR. NAKOSKI: Mr. Leitch, if I could answer that. An example at South Texas, for example, a gauge in a safety related system that's just used to collect data. It doesn't perform any function. Answer does it initiate an event, you're going to say no so it's zero. There's a lot of times when you answer those five questions you can have a zero.

DR. UHRIG: Then you do have a zero one type thing multiplying.

MR. NAKOSKI: It's a zero if it's no and it can be one through five if it's yes based on --

DR. UHRIG: Okay.

MR. SIEBER: Mr. Chairman.

DR. BONACA: With that, any other questions? I think we will have to make a decision later. I think we should have also the chairman here to make a decision on whether we should write a report. We heard the request and that may be appropriate at this time.

If there are no further questions, at this point we'll take a break for 15 minutes and resume again at 20 of 11:00.

(Whereupon, at 10:26 a.m. off the record until 10:40 a.m.).

DR. BONACA: Let's resume the meeting now. I wanted to start on time because we have Mr. Grimes here who came to help us and Mr. Prato who is the present manager for the Arkansas One License Renewal Application.

The intent here for me was to provide you with a summary of the meeting that took place last week on this subject. We decided not to have a full presentation to the committee because, you see, this application is very similar to the Oconee applications and we felt there were no issues that deserve at this time to have a full presentation from the applicant and the staff or the full committee.

The intent right now is not to write an interim letter at this time and distribute to you a two-page summary that I put together for my own use to keep a memory for the final report we'll have to write when the open issues are closed.

This summary that you have in front of you does not contain information on the open items. I

will provide it to you as I walk through these paragraphs.

Also, this two-page summary. On the second page at the bottom has Jack Sieber written in. For some reason his name got into it but he doesn't belong there so disregard it. As you can imagine, I was surprised when I saw that but somehow it got there. This is to do with some of the intricacies of computers I guess.

DR. SHACK: Of all the random things to type Jack Sieber seems pretty far down on the list.

DR. BONACA: So let me just walk through a little bit this summary.

On February 22 we met with the representatives of the applicant from Entergy for Arkansas One and presented to the staff to review the Arkansas One license renewal application and the interim SER.

The SER we just call interim because the open items are now closed. Arkansas One is a B&W-type PWR designed to generate 2568 megawatt thermal or about 836 megawatt electric.

Now, the reactor is very similar to the Oconee units that we recently reviewed and for which have approved those who participated in the approval

of the SER and of the application.

Because of the similarity Arkansas One has utilized a lot of the lessons learned from the license renewal of Oconee. In order to benefit from these similarities, we asked the staff to provide us with a presentation that would highlight the differences between the applications for Oconee and for Arkansas, as well as the differences in the solutions which means specifically age and management programs that they have chosen if there are differences.

The reason is this will allow us to benefit from previous experience. I would rely on your judgment for future applications if that's the right approach. I believe it is the right approach because it allows us to keep our memory of where we're going, even for the BWRs we are going to review with the exceptions of the reactor vessel and other components which relate to that.

There is so much similarity in the applications from PWR and BWRs simply looking at passive components so the staff provides us with an informative presentation which was really based on the formative comparison.

The second observation I would like to make is that the application which appeared at the

beginning quite condensed was quite effective, I think. I'm giving this feedback because it really was easy to review it for a number of reasons. One is it contained in the back a number of appendices which condensed the information we needed.

For example, Appendix B contained a full summary of all the problems that are being credited for a license renewal and also segregated the first seven problems and new problems. The rest were existing problems. That really helps understand where the new issues are, where the new problems are. That was, in my judgment, a very good format.

Appendix C described the approach that was chosen to manage aging effects. Also that was very helpful because, again, you have a full dedicated appendix where you can go to look for those solutions.

I just bring up these issues because I don't know to what extent the next applications will reflect this format but maybe there is some chance because of the NEI.

MR. GRIMES: Dr. Bonaca, this is Chris Grimes. I would comment that I think you'll find Arkansas is very close to the standard form and content that we are recommending in the standard plan and the NEI guide that we would endorse with the

regulatory guide.

DR. BONACA: Thank you. With that, in general the subcommittee had the following observations or questions regarding scoping and screening. The scoping and screening methodology devised by the applicant identifies components appear to be well structured and comprehensive.

This methodology we know is consistent within the I-9510 and also with the NRC SRP. The Arkansas One FSAR was facilitated in many ways because the definition that Arkansas has used for safety related is the same definition that the license renewal rule uses for safety-related components.

Also, the Arkansas One Q-list include all the support systems of the safety-related component or those systems which are not safety-related but whose failure would cause safety-related systems not to be effective. Therefore, because of the definition that they have used for actual list, it was easy for them to pull those lists out and say these are the components which are in the scope of license renewal.

Actually, in addition to that, the Arkansas application included a number of systems and components which were included in the Q-list purely because they could have interference with safety-

related systems by physical interaction, for example.

That expanded somewhat the scope and the feeling you get when you look at the application is that the scope in general is pretty conservative. It went beyond the requirements of the rule in my judgment.

DR. WALLIS: Can I ask you about electrical cables?

DR. BONACA: We'll get there.

DR. WALLIS: This may look like Oconee but the cables can be quite different. We know that there is degeneration of cables. I was looking at the hatch which is a different one all together. I couldn't quite figure out why some of the cables got screened out and some of them were considered because we know the cables do deteriorate. Do they pay proper attention to the cables?

DR. BONACA: I think for the EQ medium voltage cables they are going to be subjected to the requirements that result from the generic issue resolution.

MR. GRIMES: Dr. Bonaca, I would like to clarify there are three points that are raised by Dr. Wallis. The first is with regard to scoping and whether or not particular cables are screened out

based on function.

As I recall Arkansas uses a spaces approach so they would only screen out cables if there aren't any in the space. We were confident that the scoping will capture all of the requisite cables whether they are subject to EQ under 5049 or not. We rely on the process for compliance with 5049 to maintain the qualified life for EQ cables. For non-EQ cables the applicant has proposed to --

Is this an open item?

MR. PRATO: An open item on medium voltage cables -- this is Bob Prato -- that are inaccessible and that can be exposed to underground conditions.

MR. GRIMES: And we would expect the same form of resolution that we achieved on Calvert Cliffs and Oconee.

DR. BONACA: I never thought about the medium voltage cable because it's an open item.

Regarding scoping and screening again, I said before that it seemed to me it was quite comprehensive and went somewhat beyond the narrow interpretation of the rule.

There are two open items on that. They have to do with the flow orifice that brings in the sodium hydrazide and the question is why is it not included

in the scope. The other issue is why are a number of fire protection systems and components not in the scope.

My sense is those are good questions. I understand the reason for the resistance on the part of the applicant about his issues. It's simply that they need to provide more information to bring closure to these issues. We felt that we agreed with these questions and they need to be addressed.

These are the only open issues on scoping.

Now, the subcommittee also raised a number of specific questions on scope. We made an effort of raising questions regarding systems that have the appearance of having been in the scope and they were not.

To all those questions we raised during the subcommittee we got answers from the licensee on the staff that said that either there was a good reason why they were not scooped and we accepted the reason, or they indeed were in scope.

Often times the reason why there was a disconnect in the understanding is that the application included in scope, the SER included in scope because there had been already communication between the staff and the licensee and that brought

the component in scope.

Now, we asked questions regarding these issue. Would the application be modified to include those changes which were negotiated in the federalization of the SER and the answer was no but the FSAR update will include those commitments.

Regarding the process used by the applicant for defining aging effects requiring aging management, that process appears to be comprehensive and effective. They used a new approach where they have a set of tools in what they call Appendix C.

In our review we found that the application has considered the aging effects we have seen in previous applications. They really have applied the lessons learned from previous applications. That's pretty obvious.

There are some open issues regarding some of this aging management programs. They have to do, all of them in my understanding, with additional information to better understand why they are effective enough to deal with the aging management issues. Is that correct?

MR. PRATO: This is Bob Prato. What they need to do is they need to add additional description to the FSAR supplement. There are 11 of those items

where the description that they provided in their application was inadequate and they needed to provide more information in the supplement itself.

DR. BONACA: So I understand in that sense there is no contention there except you want to have more information and detail on what they are committing to.

MR. PRATO: That's correct.

DR. BONACA: In the section that has to do with limited aging analysis, there also seems to be a pretty comprehensive inclusion of all the issues they've seen for other plants. There are a number of open issues on this.

One has to do with the -- well, one has to do with additional information also regarding TLAA in the addendum to the FSAR.

Second has to do with buried medium voltage cables for which the staff is contending that similar cable not in similar environment is not indicative of the status of the one which is buried and, therefore, cannot be used as an indication and they are requesting a program for that and we fully agree with that kind of perspective and we are going to see that there is closure on this issue.

There is another TLAA which is still open

regarding the specific criteria to be used for forces of the Arkansas One containment. That's also, it seems to me, reasonably similar to the Oconee questions that we had. I would expect to have a similar closure on that.

There is finally an open issue of the aging of boroflex. During the presentation we are told that the applicant has agreed that is a problem even for the current life and, therefore, they will provide a solution that doesn't address specifically the extended life but specifically boroflex now.

I guess the question I have for the staff is are you looking for a commitment at this stage?

MR. GRIMES: Dr. Bonaca, this is Chris Grimes. The controversy evolved primarily because the applicant chose to challenge the definition of a time-limited aging analysis to put this into the context of a corrective action.

We don't want to argue about whether it's a time-limited aging analysis. We believe it is. What we're trying to focus on now is establishing confidence that there are program attributes associated with the corrective action that can be relied on in a programmatic way.

We don't necessarily need to know exactly

how the life-limiting aspects are going to be fixed, but we want to know that there are the 10 program elements in place that will ensure that before there's a loss of function corrective action is taken. I think we'll be able to work that out with the applicant.

DR. BONACA: The only surprise I had somewhat there is that for initial the nature I know that other licensees have already developed plans to deal with what is the criteria which you've cited at some point you cannot operate any further so some of them assume that they have certain split open spaces or assume that you have large gross formation of boroflex. I was somewhat surprised that Arkansas did not have a problem with the nature.

MR. GRIMES: Actually, I think Arkansas was also surprised. I think they had envisioned that this was an issue that they could deal with in the future and they had originally, and Bob can correct me if I'm wrong, it originally said that, "This is a time-limited aging analysis and we can manage it."

Then they were surprised to discover that the inspection results did not support the current licensing basis. They were trying to get positioned so that when they deal with the future of their spent

fuel capacity and the maintenance of that facility, that they would decide how to deal with it. I imagine that it was for timing more than anything else for Entergy.

DR. BONACA: Okay. I already spoke about the effectiveness of Appendix B. Having this summary listing of problems has allowed us to really get a sense of the extensiveness of the problems.

Appendix B is formatted in a way where you have this seven new problems. Then you have all the other problems which already exist but some of them are modified to deal with some of the issues which will be raised in the context of license renewal.

In my review of the SER, it was apparent that the staff had performed an effective review of the Arkansas One application. We asked questions regarding the process that was used and there were two processes.

Certainly the first one is a lesson learned also for the subcommittee licensing ACRS. They specifically take systems of components which are not in scope and test why they have been left out. Now, that's a guidance which is also given in this SRP, but I think this time I use it personally and I found I had a lot of questions.

Each one of us has a sense of what really should be a safety system. For example, the Fussel-Vesely measurement device does not have any other function than the safety function. The question of why it's not in scope is a good question. The answer is provided and so it was acceptable but I think that was an effective review that the staff performed.

Another question we asked was regarding the staff visits to the site. They were performed by the staff and clearly they had done a reasonably extensive process of V&V, validation and verification. I believe there were two trips to the site involving several days and several people.

MR. PRATO: This is Bob Prato. There was actually three. There was an audit for the methodology review. Then there was a scoping inspection to verify the implementation of the methodology. Then there was a two-week aging management review.

The last two, the scoping inspection and the aging management review, involved seven spectors and the scoping methodology, the week that we spent on site, involved three engineers from the site -- from headquarters. I'm sorry.

DR. BONACA: The second visit was for what

you said?

MR. PRATO: For verifying that they implement the scoping methodology correctly. It was a scoping inspection. During that inspection we actually looked at systems that were excluded and verified that they had good justification for excluding them. Then we looked at the structures and the components individually and made sure they included them correctly as well.

MR. GRIMES: This is Chris Grimes. Just to make sure that we keep the process clear, we refer to an audit of the methodology. That is the team from headquarters that goes down and gathers information first hand that they use to prepare their safety evaluation of the methodology.

The other two pieces are the scoping inspection and the aging management program inspection. Both of those are conducted under inspection manual chapter 2516.

Those inspection reports then support the recommendation by the regional administrator. That is when we go back to the path that shows all the contributors to the evaluation findings. We try to keep the product lines distinguished.

DR. BONACA: Okay. The subcommittee noted

that a number of new problems and one-time inspections, seven in total, have decreased significantly from the first application. The first application had 30 odd one-time inspections and this one has two.

We asked questions of the staff and the reason clearly is that a lot of the open issues have been addressed now. I would like Mr. Grimes to describe the reason.

MR. GRIMES: Dr. Bonaca, as we've reflected on our ability to explain to the ACRS the consistency and the treatment of our review process, we discovered as time as gone on we've learned some lessons. We are going to explain those to the committee when we present the generic aging lessons learned report.

One part of this is evidence that lessons have been learned and applied. A second part is that the numbering system, the accounting system has changed from plant to plant. If you recall, for Calvert Cliffs we counted some 436 programs. We were actually counting individual procedures.

On Oconee we had roughly the same number that Arkansas reports and that is about 30 programs. Also, there is a reflection here that Arkansas was much more aggressive than Calvert Cliffs or Oconee or

even the industry in general in their GALL approach. Arkansas has leaned forward and they are taking on a number of these routine inspection activities.

I think the best example is by going to a risk-informed service inspection program they captured small bore piping which is a one-time inspection in GALL and it is still a controversy with the industry in terms of whether or not license renewal should be solving that problem or some industry initiative should be credited for that problem.

I do think that is appropriate that we should give recognition to Entergy's aggressiveness in treating these areas. That accounts for part of the reduction, too.

I have also committed that when we come to explain GALL to the committee, we will provide a cross-reference of what was done for Calvert Cliffs and Oconee and GALL in order to show the evolution of the learning.

DR. BONACA: I believe that's really very useful to the committee if we can get this perspective of how those one-time inspections have evolved. I looked at some of the one-inspections which were in Fussel-Vesely terminals and they are, in fact, included in the program here and there was no specific

identification separately of the one-time inspection.

It was simply folded in the problems as some of the other applicants have done, too. I did it not under duress but still under some kind of negotiation and had to choose how to do it.

Clearly, Arkansas came in and I believe that as the industry accepts this kind of resolutions, these will facilitate the next applications and reviews.

During the subcommittee meeting we noted a number of apparent inconsistencies between the application and the SER information already assembled when we were talking about scoping but we found it mostly in the problems.

Typically, again, discrepancies were tied to the fact that the applicant proposed some program, for example, visual inspection of some piping. The staff said, "Visual is not enough. You should have ultrasonic examinations."

The applicant agreed so the SER documents ultrasonic testing as the program used to deal with a particular issue while the application still quotes visual so there wasn't really a discrepancy there. The discrepancy had been either solved.

Typically the discrepancy resulted in an

augmented program in the SCR than was presented in the original application. I understand that the addendum to the FSAR will contain all the commitments anyway so there will be commitments as reflected in the SER.

In conclusion, the feeling we got as a subcommittee was that the staff has performed an effective review of the Arkansas One application. The Arkansas One application is an aggressive application that went, from what we can see, beyond the minimum requirements of the license renewal rule.

Therefore, we felt confident that we understood enough to stay with the process right now. We recommend the committee that we do not at this time write a letter.

We also would not conduct a subcommittee meeting to review the closure of the open items because there are very few. Are intent is they want to bring in now the staff back the applicant for a full committee meeting when the open items are closed. Hear a presentation by the applicant at that time and hear a presentation by the staff and we will write a report at that time.

Any questions from members or staff?

DR. WALLIS: The CD that we have with the application, nothing has changed from that so if I go

back to that to look at things, that is the key document to review before our next meeting?

MR. GRIMES: That's correct. The CD contains the application as submitted and it also provides the FSAR. Dr. Bonaca has made the point that when you review the safety evaluation, the safety evaluation will articulate the paper trail from the application to a resolution. All the correspondence that has occurred in the intervening time should be clear in the safety evaluation.

MR. PRATO: This is Bob Prato. All that correspondence is identified by dates and each of those letters that were provided by the staff and the applicant are on the docket. There is a complete paper trail on the docket. If you need anything specific, though, feel free to call us and we'll make sure you get a copy of whatever you need.

DR. BONACA: Tomorrow, I believe, we will also talk about the Hatch application. The SER is coming to come for our review. Well, you probably already received it at home.

With that also we have two subcommittee meetings, one that will lead us to review the guidance documents, the final changes to those. A second meeting on the BWR VIP which support in some form the

Hatch application.

We have talked about having a presentation of the Hatch application and the SER in the same format by emphasizing the similarities with even PWRs given the fact that there are so many classes of components or commodities that are similar irrespective of the type of reactor that is being used.

MR. DUDLEY: This is Noel Dudley. I do have those documents in house. I can send them out either express mail if you want to start working on them Monday, or I can send them regular mail and you'll get them Wednesday or Thursday next week.

DR. BONACA: These are the SERs?

MR. DUDLEY: These are the SERs. These are four BWR VIP reports, associated SERs, and all the proposed final draft of guidance documents.

DR. BONACA: Guidance documents. Okay.

MR. DUDLEY: Well, say the March 1 draft of the guidance document.

DR. BONACA: So all the members of your choice. You can take it with you.

MR. LEITCH: It's 1,700, 1,800 pages.

DR. BONACA: What we thought of doing was to send to you only those sections that you are asked to

review.

MR. DUDLEY: I think the document is small enough. The actual GALL report now is only a couple inches.

DR. BONACA: It's small enough you can memorize it.

CHAIRMAN APOSTOLAKIS: Is anyone dying to have it in his hands by Tuesday or Wednesday?

DR. WALLIS: I would love to have a CD rather than a big pile of paper. That means someone has to scan it in presumably which is a pain.

MR. DUDLEY: Disks for the guidance documents are not available yet.

MR. GRIMES: This is Chris Grimes. We had envisioned putting them together on a compact disk after they are approved. I'll explore the possibility of having the files loaded onto a CD-ROM.

You wouldn't have the benefit of the electronic book features with tables of contents and so forth but if you're more comfortable in working in electronic forms, we can have Word Perfect files assembled on a CD for portability.

DR. SHACK: How about PDF?

MR. GRIMES: I hesitate to say that because we would have to pull the PDF files out of ADAMS and

I would rather not.

DR. SHACK: When I get Word Perfect documents from Paul my computer thinks they are PDF files anyway.

DR. BONACA: So we'll do that. I just want to ask if there are anymore questions from members. No further questions. With that, Mr. Chairman, I give you this 32 minutes of time.

CHAIRMAN APOSTOLAKIS: The Chair expresses deep gratitude.

We were hoping to go over the ATWS letter because we have a new version of it. No, we don't need the description now.

(Whereupon, at 11:14 a.m. off the record for lunch to reconvene at 12:46 p.m.).

A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

12:46 p.m.

CHAIRMAN APOSTOLAKIS: We are back in session. I neglected to mention this morning that we have Dr. Peter Ford sitting with us at the table as an invited expert.

The next session is on Spent Fuel Pool Accident Risk at Decommissioning Nuclear Power Plants.

Dr. Kress, you are the leader on this.

DR. KRESS: Yes. It's a simple, noncontroversial subject.

CHAIRMAN APOSTOLAKIS: We should be done in five minutes then.

DR. KRESS: As you all recall, there was a technical study on this issue intended to give guidance on how to develop a rule or exemptions to relax requirements at spent fuel pool, requirements on emergency preparedness, and perhaps insurance requirements and security requirements.

We reviewed that technical study and give it fairly good grades, I think. They determined that the risk after a certain amount of time was low enough that you could do without the emergency preparedness and still meet the safety goals and this risk was done a fairly conservative basis.

They also noted that previous exemptions for these sort of things were based on the concept that you couldn't have a zirconium fire after a certain time because the heat generation rate was too low. It was balanced by the cooling rate so that you weren't hot enough to start a fire.

The staff to some extent backed away from that concept and said they couldn't exclude the zirconium fire, whatever that means. I think there was some differences of opinion between the industry and the staff on these things. There have been some further correspondence and some discussions.

I think today I view this as more or less a status report or an update on where we are with respect to publications on possible rule making options. I don't think we are ready for a letter again this time. I don't know. It depends on what we hear.

With that as a sort of vague introduction, I'll turn it over to Tim Collins of NRR to get us started.

MR. COLLINS: As a status report this will be a real quick meeting. The status report is that the study is done and we're starting to do the thinking on the policy options.

There are a couple of things, though, I would like to provide a little clarification on. When we started out the study, the charter was not just aimed at EP and insurance. It was to provide a broad basis for rule making relative to decommissioning plants as a whole.

There was some emphasis in the report on EP because of the number of exceptions that had been granted in the past and the most recent actions in decommissioning were requests for exemptions in decommissioning or insurance.

Another thing I would like to make a clarification on. The finding in the report with regard to not being able to preclude a zirconium fire. The finding in the report was really that we couldn't define a generic time without numerous constraints, okay?

The original exemptions were granted on the basis of an unobstructed airflow calculation, those previous exemptions which said after a certain number of years you wouldn't get to a temperature that would lead to a fire.

When we originally tried to do the study, we started out with the unobstructed airflow cases. In the course of public comment there was questions

raised with regard to partial uncovering of the fuel which would obstruct airflow.

We also in trying to do our own calculations we were trying to decide how much airflow we should be using. We ran into problems with different rack configurations, different spent fuel pools, the relationships between the building airflow and the flow in the racks.

Then when we looked at our results, we said the most likely events that could get you into trouble were major seismic events and major cast drops, all catastrophic events. We finally threw up our hands and said we can't define the geometry which will allow us to do as calculation which will give us a generic decay heat time.

I think the characterization that the study concluded that you could never preclude it is a little bit of an alarming characterization. It's more a matter of, well, there are so many uncertainties and so many unknowns in trying to do a generic analysis that we couldn't come along and say after five years we're sure there's not going to be a fire.

As far as where we go now, I mean, as far as any technical work goes, it's at a standstill. We believe that the results of the report were -- the

staff is comfortable that we are below the safety goals. We think that additional technical work could be quite expensive if it's going to really significantly reduce uncertainties further.

We're not sure what goal we would be shooting for if we started to do that work so we're in the position of developing policy actions for the commission. The policy actions are aimed at questions like how important is factors like public confidence in your decision making process.

I mean, we believe that the risks are very low and below the safety goals for reactors, but there is a very significant question in areas like emergency preparedness, how important of a factor is public confidence and how does that weigh into decision making. These are the types of things we are going to address in our May paper to the commission. There is also questions of how do we use risk in security related --

CHAIRMAN APOSTOLAKIS: I'm sorry. This issue of public confidence, maybe we can clarify it a little bit. You see, you believe that the risk is low. When you say that, you mean the whole distribution is below the goals or the mean value is below the goal but there is a tail that goes perhaps

above?

I'm trying to understand the meaning of the statement and why some other groups might differ, I mean, with the issue of confidence. When the staff says the risks are low --

MR. COLLINS: When we did our analysis, we tried to use a range of sensitivities. For example, in the seismic analysis we used the Livermore curves. We used the EPRI curves. We did source term sensitivities to include large amounts of ruthenium release, what we thought was a reasonably large fraction of fuel finds. Using those bounds, we believe that the risk is still below the safety goal.

CHAIRMAN APOSTOLAKIS: You did not quantify the uncertainty?

MR. COLLINS: We did not quantify the uncertainty.

CHAIRMAN APOSTOLAKIS: Just sensitivity studies?

MR. COLLINS: That's correct.

CHAIRMAN APOSTOLAKIS: And what you thought were bounding analysis?

MR. COLLINS: Yes.

CHAIRMAN APOSTOLAKIS: Okay.

DR. POWERS: It must surely be if the risks

are low and you use high source terms, that is, just the frequencies were low. That's the only reasons.

MR. COLLINS: Sure. I mean, the frequencies were very low.

CHAIRMAN APOSTOLAKIS: The frequencies of what?

MR. COLLINS: The frequency of -- what we calculated in the report was the frequency of uncovery of the fuel. We didn't try to do a calculation of the conditional fire probability. We went from uncovery of the fuel to consequence analysis.

DR. KRESS: And it was driven by seismic.

CHAIRMAN APOSTOLAKIS: So why would someone else then have less confidence in what you did?

MR. COLLINS: Let's find that someone else and ask them.

CHAIRMAN APOSTOLAKIS: I mean, how can you take into the decision making process the fact that others have less confidence in your results unless you understand why? You raise the issue of how do we make a decision if the public doesn't agree with us. Who is the public anyway?

DR. POWERS: I think we have to go back and look at what some of the other speakers had to say. We had several speakers at our meetings and some of

them -- the universal sentiment was that the issue deserved more attention.

When you looked at the more attention that they were asking for, in general each person said that there are design specifics at each site that make a generic conclusion difficult to draw. You have to go look at those design specifics and they make a different.

Now, the difference they were asking for, of course, depended on point of view a little bit. So one of the questions that comes out of that is does the generic analysis give you the answer or is it always the site specific analysis that you have to do?

The other distinct point of view was that looking at this strictly from an accident probability is the wrong way to do it. In fact, there is a security element of this as well so you have to take into account both misadventure and deliberate actions here in making decisions about these pools. Those were the alternatives.

The one I think the staff is in a position to address is the one can you get any mileage out of a generic analysis or are all things so site specific in the phenology affected by that site specificity that you just don't derive any answer.

MR. COLLINS: I mean, certainly in the development of a rule if we were depending upon generic analysis, one of the elements of the rule would have to be demonstrating consistency with the generic analysis, or that you were bounded by the generic analysis, or you would do your own plant specific analysis. That's typically what we do with rules anyway.

We review topical reports all the time where generic analysis are submitted and then we get a plant specific submittal which references the generic report and just demonstrates why it's founded by the generic analysis or where it's not and why it's still okay. The rule would have to be structured in such a fashion if it's going to depend upon --

DR. POWERS: You can do that in a rule but I would think you would come into the rule saying, "My generic analysis is going to be pretty good or 90 percent of 90 percent of the site specific things." Do you have any feeling for that?

MR. COLLINS: This analysis?

DR. POWERS: Yes.

MR. COLLINS: I think this analysis would be applicable to most facilities, yeah.

DR. POWERS: Okay. That gives the answer

the chairman was looking for. It's contrary to what speakers on both sides of the issue have said.

MR. COLLINS: Well, I understand that. In some cases on one side of the issue speakers would say that the risk is so much lower. That's fine. That's okay. If they want to do analysis which shows it's lower, we'll find that just as acceptable.

CHAIRMAN APOSTOLAKIS: Are you done?

MR. COLLINS: I think I'm pretty much done. I mean, there's not much more to say. We just started developing the policy paper.

DR. KRESS: That's going to the commissioners in May?

MR. COLLINS: Yes.

DR. KRESS: Near the end?

MR. COLLINS: I expect it will be about May 31st.

DR. KRESS: We could probably here a draft version of that in our May meeting, you think?

MR. COLLINS: Well, a different group is responsible for the development of that paper. I don't want to commit them.

DR. WALLIS: So have you concluded the better understanding of the physics, chemistry, and so on of fires is not to be sought because the risk is so

low?

MR. COLLINS: Staff is not recommending that we do additional analysis at this point. If the commission decides that we need it, we'll do it.

DR. KRESS: I think there are broader applications or needs for such stuff. For example, with respect to pressurized thermal shock, which may be an iron ingression type accident also. There may be other reasons other than for decommissioning for such research but you're not excluding that in particular?

MR. COLLINS: No.

DR. KRESS: Just for the decommissioning?

MR. COLLINS: I'm talking about for decommissioning rule.

DR. KRESS: I think you probably have enough for a decommissioning rule maybe.

DR. POWERS: I guess I have a couple of questions on that. One of them I would like to come back to is the statement that things are dominated by seismic.

I have been given a sheet of paper which, unfortunately, I don't have right here with me, in which initiating events for fires in the pool were listed down and the percentage contribution was

provided. That list of seismic only is 13 percent. It wasn't even top on the list and there were several comparable to it.

Naturally enough, I can't remember what the others were but they certainly involve station blackout, loss of cooling capabilities.

Is it true that this thing is totally dominated by seismic?

MR. COLLINS: We believe the seismic clearly dominates it. We took into account events where you had loss of cooling to the pool. You can look at it as two basic types of events. You have a catastrophic draining of the pool or you have a slow boil off or a very slow leak, those two types.

Now, the second type of event, the slow one, is dominated by human error and there's hundreds of hours for recovery actions in the secondary. We looked at that very carefully. We had several back and forths with the industry and I think with the committee even on the human error assessment. When we were finished, we found that the seismic events were dominating.

DR. WALLIS: Well, human intentional error like deliberately turning on pumps which would drain pools or something like that?

MR. COLLINS: Errors of commission as opposed to errors of omission.

DR. WALLIS: It might well be that your risk levels are so low that the unexpected wayward performance of one individual might have --

MR. COLLINS: Still the recovery time was important more than the initiating event frequency if it was started by someone turning on a pump.

DR. WALLIS: So they cannot drain the pool rapidly? It takes many days or something? I don't know.

MR. COLLINS: It depends on how big the pump is, I supposed.

DR. WALLIS: That's right. That's an obvious statement. How long does it take?

MR. COLLINS: I'm not sure if we looked at someone deliberately pumping the pool out.

DR. WALLIS: But you may have risk levels so low that that sort of event is the thing you have to worry about.

DR. POWERS: You are ham strung. You have no way of estimating the probability of that initiator.

DR. KRESS: That's right.

DR. POWERS: That's the fundamental problem.

The ground rules on any kind of risk is that risk is going to be taken out. That, of course, means that somebody has to say those kinds of risks are handled some other way or are small enough that I don't need to worry about them.

We have the same problem with sabotage, somebody from the outside attacking the pool. We try to handle that by putting fences up and a few guards and things like that.

Similarly the kinds of people that you hire have some sort of screened background and don't have a predilection for sticking pumps into spent fuel pools or something like that. Those kinds of measures are taken. You can't put it into a probalistic frame work.

DR. KRESS: You cannot put it into a probalistic frame work?

DR. POWERS: People certainly haven't found any way. What they have found is I can produce an estimate of the probably of an error commission. What I can't do is produce an estimate that I can persuade Tom is correct.

DR. KRESS: That's correct.

DR. POWERS: I can do it.

DR. KRESS: It can be done.

DR. POWERS: But I can never persuade you. Now, one could imagine that you could sit down and have a panel of experts persuade each other what it is.

The problem is no one ever felt like they could take that product and put it forward and convince anybody that these people were so profound in their expertise on people sticking pumps in spent fuel pools that their estimate was better than anybody else's.

MR. LEITCH: In terms of error by omission, it seems to me, and my memory is a little fuzzy, but in Dresden about four or five years ago there was a freeze up and I think a line had ruptured in an attempt to drain the spent fuel pool. Did you think about things like that?

MR. COLLINS: Yes, we tried to look at all the operating events that we were aware of that could have led to a pool draining. It's considered in the likelihood of the initiating event.

DR. KRESS: We went over all these questions when we reviewed the technical study. We convinced ourself that they did a pretty good job.

CHAIRMAN APOSTOLAKIS: Do you want to say something about the options? Please identify

yourself?

MR. HUFFMAN: My name is Bill Huffman. I'm with NRR and I'm the project manager for the policy paper. I think your question was would it be ready for a briefing the first week of May. I would hope it would be in a draft stage at that time.

However, I would say that it would certainly have to be a closed meeting. It's predecisional. It's not something that we want to have the public privy to before we went to the commission on. Plus, there would probably be safeguard information.

CHAIRMAN APOSTOLAKIS: I don't understand. Don't we always review things that are predecisional?

DR. KRESS: Yeah, but he also brought up the safeguards.

CHAIRMAN APOSTOLAKIS: Okay. Okay.

MR. HUFFMAN: My schedule right now did not factor in briefing ACRS and I'm not sure exactly what a lead time you would want on the draft.

DR. KRESS: About a week.

CHAIRMAN APOSTOLAKIS: Thirty days.

DR. KRESS: In this case we'll make an exception. Two weeks.

CHAIRMAN APOSTOLAKIS: How big is it going to be?

MR. HUFFMAN: Fifteen pages.

CHAIRMAN APOSTOLAKIS: Two weeks then is reasonable.

MR. LEITCH: Are there not certain decommissioned plants now that have spent fuel pools where they have backed off on emergency preparedness and security?

MR. COLLINS: Yes. We've granted exemptions to several plants for emergency preparedness, insurance, and security.

DR. KRESS: And those were generally based on the problem that they couldn't have a fire after a certain amount of time?

MR. COLLINS: It seems each exemption was granted for a different reason. Generally, though, often a part of the basis was the fact that you couldn't have a fire anymore based on an assumption of unobstructed airflow calculation.

DR. KRESS: Then you don't feel like you need to revisit those because the risk is low.

MR. COLLINS: No, we intend to go and revisit them. We believe that the risk is low enough there's not a safety concern with those. We were maybe in a situation where the basis is not correct for the exemption. We plan to revisit those. In all

cases, I think the most recent -- the freshest fuel is almost four years old in the facility with the hottest fuel.

DR. KRESS: Long time.

MR. COLLINS: A long time.

DR. KRESS: I think we are also scheduled to hear from the industry.

Lynette, are you going to take the lead on this?

This is Lynette Hendricks with NEI and our old friend Bob Henry with Vaski and Associates.

MS. HENDRICKS: We appreciate the opportunity to revisit this issue with you. We see it, I guess, in maybe a little more of an evolutionary stage than maybe the staff views it.

We would like to basically talk about two issues today. One are some of the little touch on the phenology questions that were raised last time. Some information on the basis for the cask drop. Then finally with great boldness I would like to have a short discussion and get some input on the seismic question.

With that, I'll turn it over to Bob.

MR. HENRY: As Lynette said, we would like to offer some suggestions because we think there are

some issues that can be dealt with a little more crisply in the report and take advantage of a lot of the experimental data that has been acquire by both the NRC and the industry over a number of years.

I would like to be constructive in that regard and offer some suggestions of things that could be incorporated in the report. As Lynette said, at the end she has some comments on seismic. The issues I would like to particularly address to start with would be the experimental basis that we could subscribe to catastrophic events to get a somewhat better perspective of the potential damage that could really cause.

The last time we had the opportunity to visit with you we talked a little bit about fission product release, particularly ruthenium under those conditions where the pool has been assumed to be drained rapidly.

The at the end also talk perhaps a little about suggested peer review to make sure that all of the data that people have at their disposal gets input into these kinds of documents that do get used for policy making.

I should also say we're talking about the cask drop here just as Tim was just saying. We are

focusing on the likelihood that could be a mechanism whereby the pool would be rapidly drained. There is some data that I'll share with you here that I think the study could benefit from by incorporating and suggest that this is a pretty difficult thing to do.

To start with, we feel that the status is that this provides a good start for quantifying the risk for significant fission product releases. We think it's certainly a good basis. Tim was just talking about all the field information they went through to provide quantification of the likelihood of losing pool cooling.

We also believe it should incorporate these experimental results, I was mentioning, that one could use to evaluate the likelihood that a cask drop could indeed cause rapid draining of the pool.

Also, we believe that there is a technical basis to be incorporated into the report to at least give a best estimate in addition to the bounds that are already in for fission product releases and, therefore, health consequences.

I think if we do a little bit more than just provide the bounds, we provide some additional insights on how people might be using this to make judgments.

To start with, let's start with the experimental basis for assessing cask drop. I've listed four references I was able to dig up. The first two being with full-size casks dropped onto concrete pads where they were principally there to measure the damage to the cask, but they also recorded the damage to the concrete. We can certainly use that to assess our ability to determine how tough the concrete really is.

The third one is an NRC study using steel billets dropped onto concrete surface that is very useful. However, the first two I'll use this afternoon because the information for the compression of the concrete in the locality impact is reported.

The last one are some experiments that were done quite a while ago for high velocity impacts that really relate to tornado missiles but from a practical point of view they are just as usable, as we'll see, as the first two in terms of assessing what the implications would be for impacts on concrete.

DR. WALLIS: When you talk about a pool, what part of the pool is being hit by this cask?

MR. HENRY: Conceptually, just think that the cask has been lifted up and is somewhere around the top of the pool, the rigging breaks and it comes

down through the pool.

DR. WALLIS: Through the pool of water?

MR. HENRY: Goes through the water.

DR. WALLIS: Doesn't that slow it down quite a bit?

MR. HENRY: It does a little bit. We'll talk briefly about that. To give you a feel for it, the terminal velocity of water is maybe in the range of 20 meters a second if you just use a drag coeffision of one. You'll see this has fins on the side and maybe that slows it down a little bit more. The 20 meters a second --

DR. WALLIS: In your picture, it goes through the pool and hits the bottom of the pool.

MR. HENRY: Correct.

DR. WALLIS: It's not knocking off a piece of the sidewall or anything?

MR. HENRY: In what I present today, no, but this fourth set of experiments here do have experiments where the projectile was at a 45 degree angle also. I didn't include those here because this is a fairly quick thing but you could certainly use those. What they did observe in those is that it principally just grazed along the side and didn't do anything to cause a large rupture of the wall.

I apologize for the simplicity of this. There are correlations for this. I chose not to get into correlations but to just use it from a very fundamental point of view in terms of the mass and how far it's going to fall, plus the strength of the concrete and the dent it will make in the concrete delta and the kinetic energy.

All this does is equate the change in kinetic energy to the work done and the work is just the force of compressing the concrete times delta. This delta is the dent that it would make in the concrete or how far it has to go into it before we finally can get something that actually opens up a hole that could drain the pool very quickly.

DR. WALLIS: The biggest uncertainty is A. I mean, how does it fall. Does it fall in a corner. We have to put in an A here. That's the biggest uncertainty.

MR. HENRY: Again, I didn't focus on that today. I wanted to make sure the database was available to everybody and understood and discussed. Again, going back to the tornado missiles, they used As which were very small like rebar.

The part that I'm going to give you here is a very simple approach I'm going to use. As you start

making A smaller and smaller, this thing starts giving you far too deep of a penetration.

If you think of a corner going in first, then it's very quickly going to spread to something which is, let me say, is just half of the A of the total cask. Again, we're not close to any kind of cliff where you would almost break the pool as we'll see here.

DR. WALLIS: You are assuming that energy is absorbed by the concrete where it's hit.

MR. HENRY: Right.

DR. WALLIS: I think sometimes when you hit concrete on one side the concrete comes off on the other side but the shockwave goes through the wall, hits tension, comes off the far side of the wall. It hits the wall here and the plug of concrete goes out into the next room.

MR. HENRY: Right.

DR. WALLIS: But that wouldn't be reflected by this kind of mechanism. Would it?

MR. HENRY: It is in the way I'm going to use it as you'll see because we're going to go back to data where actually what did it take for something to fly off the opposite side.

DR. KRESS: The compressive strength, that's

force per unit area it takes to compress concrete a certain distance?

MR. HENRY: Yeah, if you want to use a simple kind of thing, it's like the yield point. Once it starts giving, it essentially has almost the same. Also there is a rate of strain that gets involved in all these, of course, but that's also not in here.

When I talk about the calculated delta, it's going to be this very simple thing of just equating the kinetic energy to the work done.

DR. WALLIS: That's an interesting one, too, because if you want to bust concrete, it depends on the size of your sledge hammer. Having the same amount of kinetic energy with a sledge hammer that weighs a ton isn't the same as having one that weighs nine pounds. It makes quite a difference.

MR. HENRY: That's correct. That's obviously all in the equation. If you do go back to this part of it and if you want to scale it then you've got this thing and here is the mass and the area that you've been focusing on.

If you want a scale from one to the other, my mass and area might be different and can I make up for it with a different velocity to get the right kind of energy. We'll get back to that in a minute.

These are the full scale tests and the results of these tests for the cask drop experiments that were done by BNFL at Sandia and also at AEA Winfrith. As you can see, this is a pretty big hammer, 64.5 tons.

The concrete's compressive strength was 22 MPAs with something in the range of like 3,500 or 3,600 psi. The drop itself -- excuse me for a second because I do have color photographs that aren't in what you have. I have six of each here if you want to pass these around and share a little bit with each other. There's three different photographs.

DR. WALLIS: This is a big flat hammer. Isn't it?

MR. HENRY: Yeah.

DR. WALLIS: You're really spreading the load.

MR. HENRY: That's why it's also --

DR. WALLIS: It's a pretty expensive hammer.

MR. HENRY: This is the apparatus. It weighs 64.5 metric tons. In this case it's held 60 inches above the surface of this reinforced concrete block and about to be dropped.

When it is dropped, this is the dent, the impression that's made on the concrete from the

highest drop of 60 inches. Here you can see the ring that's left in the concrete.

Then also this is the measurement of the deepest part of the ring which shows that the impression is eight millimeters. As we talk through this, it's that impression I'm talking about. Obviously for the first set of tests --

DR. WALLIS: Great care has been taken to spread the load as much as possible here.

MR. HENRY: I think that's why you have to look at all the databases and not just this one.

On the first case it was dropped 18 inches. If you go through the simple analysis you calculate a value of eight millimeters and it measured at the deepest point four millimeters of imprint and obviously some cracks in the concrete. But nothing was -- I mean, this is sitting on soil so nothing was broken off the other side.

In the third test it was dropped 40 inches. Here you can see that the simple way you look at things begins to fall apart a little bit but it still gives you a perspective. You calculate that you would make a dent about 17 millimeters deep or 1.7 centimeters and they measured six millimeters.

The last one, which is the picture I showed

you, they dropped it 60 inches, they calculated 26 millimeters and they measured, as we saw in the measurements in the figure, eight millimeters.

DR. WALLIS: Doesn't the whole business of impact impedance come into this, that if the concrete mass is -- it's not infrared mass so you actually set it in motion when you hit it. It's a fairly complicated problem. It's not just a question of absorbing energy and a distance.

MR. HENRY: Obviously the basic thing you have to do is absorb the energy somehow. How it all gets absorbed is more complicated than what this simple explanation shows.

DR. WALLIS: When you hit a base ball, it's different from hitting a wall. The baseball moves.

MR. HENRY: Right. From a practical point of view, the same thing is true in a plant. I mean, if it does hit the wall, the wall will bend and push it back up again.

This, at least, gives us a perspective. We can go to these other tests where it is much more focused in terms of the load. The first thing here is you see it takes a big wallop to put a hole in the concrete.

The next one, I have taken three of those

tests and shown them here. I've taken the tests which are the same missile all the time which is a 12-inch pipe and propelled at different velocities.

They also have a three-inch pipe and a one-inch pipe but there's only a couple of tests of each where this gave us a number of tests to look at different velocities, three of which I've just showed you here.

If we go through the same kind of analysis, now the missile is at much higher velocity, as you can see, upwards of over 200 feet per second when it hits the concrete. I put three of them in here because the first one is with 12 inches of concrete and this is a velocity which is big enough to drive a hole right through the whole thing.

If you look at the next sheet, that's a picture of the front and backside. The frontside still has the pipe sticking in it and the backside you can see the concrete that's blown off the back.

You want to make sure you understand what does it take to do this because these experiments tell you that it takes a certain amount of kinetic energy for a particular thickness of reinforced concrete.

The first one I have on test No. 10 is sufficient to penetrate the entire wall. Test No. 12

then is 18 inches. This is 203 feet per second, same kind of missile. Now you would calculate something that's in the range of almost a foot of penetration. The real penetration is about 7.5 inches but it is enough to start pushing some material off the back.

This again now is what the frontside looks like. You can see it's removed all the concrete right down to the first row of rebar. The backside you can see that it has spalling or scabbing off the back and you can see the exposed rebar. Maybe you would have a reasonable leak through that. You wouldn't know for sure.

Then the last one is 18 inches at 143 feet per second. This one I use, and we'll come back to it again, because there's no spalling off the back face at all on this one. Here you would calculate a penetration depth by the simple approach of 18 centimeters and the actual measured value was more like five inches. Reasonably close.

This one is important because it gives you a frontside which looks like this again, very similar to the others, but the backside -- I apologize. This is very dark but it's the best copy at the time -- there's just some minor cracks. This is not something that would drain the pool rapidly.

Again now we can work backwards and say what is the criteria now that we ought to be using to determine whether or not we have an impact that can push something off the backside and open up a whole.

I took all the information that was available on the 12-inch pipe so each one of these is the same missile. I oriented them in terms of increasing velocity here but you have to realize there are also some other things changing.

A minor thing that changes is the strength of the concrete because that depends upon the pore and what they were trying to do for a particular test. The concrete thickness is also changing. That goes all the way from 12 to 24 inches.

I've listed here the measured penetration, the calculated penetration, and then the ratio of the calculated penetration to the total thickness. Then the results over here on the right-hand column. These two I've highlighted halfway through the table and at the end so test No. 10 and 18 had complete penetration.

Here you can see that the calculated value is over half of the thickness of the wall. That's when you can begin to think that, just as Graham said, you've got enough reaction on the back surface that

you would open that up and then you would not be able to convince yourself that you did not have a complete path to drain the pool.

But these others that are very slight, 0.20 - 0.25, thirty percent of the calculated thickness, hardly anything was observed on the backside at all.

DR. WALLIS: If I really wanted to drain the pool, I would drop something on the pipe.

MR. HENRY: Most of them have pipes that the suction is on the inside.

DR. WALLIS: Penetration is on the bottom, right?

MR. HENRY: I don't know about all of them. The older ones may. Some may have that.

This is now what I use to formulate a basis to say, okay, if we have enough energy that we could penetrate something that begins to approach half of the wall, they would have to think that we could force a leak through the entire wall. That's just summarized on this.

It says first we have the large-scale tests which give us an idea of how well the simple representation characterizes what was observed in the concrete within a factor of two or three so that's a

good start. As I say, there are correlations for these things. I don't want to confuse it with correlations and get right down to the gut physics of control.

DR. WALLIS: You would be extrapolating. If you dropped a cask, it could well drop more than 60 inches.

MR. HENRY: Yeah, I'm going to get to that, too.

DR. WALLIS: You've got to use some kind of correlation to go up to that.

MR. HENRY: That's also why those high velocity pipe tests give you kinetic energy a specific loan that is greater than what you have even if it was the terminal velocity in the cask.

The observations from the high velocity missile tests, I think, are quite important and they give you an idea of how you can scale up to the things that are of interest because we do have to consider dropping from things in the range of nine meters.

We find that only relative small cracks appear on the backside as long as the calculated penetration is less than half of the wall thickness. If we don't have spalling off the backside, we wouldn't expect any large leakage from the pool.

Therefore, we ought to have something that is relatively easy to make up and slow drainage of the pool, which I think are some important insights to put into the physics side of the study because that is, as Tim said earlier, one of the mechanisms for rapid draining of the pool. It's in the study.

Now, what does this mean for the actual cask? The height that has to be used in the spent fuel pool is something like nine meters. I use nine meters here. Maybe it's 10 meters or whatever the particular event is.

It should include obviously the buoyancy and the drag of the water and the buoyancy reduces the acceleration by about a meter per second. If you just take a dry coefficient of one, as Graham was asking earlier, you get to something in the range of 20 meters per second is the terminal velocity.

The impact through water of a nine meter drop gives you a velocity of about 12 meters per second. That's only twice what you observed in this one that I passed around. Kinetic energy wise, you're only talking about a factor of four up from that particular experiment.

If I go to the experiment and say I might expect something that's about four times as deep as

what I saw, I'm only talking about maybe three centimeters whereas the calculated value would be in the range of 12.5.

DR. POWERS: Bob.

MR. HENRY: Yeah, Dana.

DR. POWERS: Maybe some stupidity on my part. You drop the cask and it's going at some velocity and hits the water. How long does it take for that velocity to full up to the terminal velocity? I presume that the terminal velocity in the air is a lot higher.

MR. HENRY: Oh, terminal velocity in the air is a lot higher.

DR. POWERS: Yeah, so that when it hits the water, it's going faster than the terminal velocity.

MR. HENRY: It's barely above the water pool

DR. POWERS: Okay. So you're saying it has almost no velocity when it hits the water?

MR. HENRY: Has almost no velocity.

DR. POWERS: Okay.

MR. HENRY: The acceleration is principally through the water.

DR. POWERS: Okay.

MR. HENRY: Just to answer your question to the extent that you asked it, you're at 12 meters. It

would take quite a bit longer obviously to get to 20. At this point the drag is roughly half of the acceleration. So now if --

DR. WALLIS: It also has an added mass.

MR. HENRY: You mean the divirtual mass?

DR. POWERS: Yeah, but, Graham, give him a break. Yeah, Bob, correct that in your calculations.

MR. HENRY: Sure.

DR. POWERS: He doesn't have any decimal points.

MR. HENRY: Everything we have comes out of one dimensional and two-faced.

DR. KRESS: The added mass is taken care of in the terminal velocity.

MR. HENRY: When you get to terminal velocity it's just equilibrium.

DR. POWERS: Tom, you're correct if he measured the terminal velocity on the cask but since he's just calculating it, it doesn't take the added mass.

MR. HENRY: The chairman told me to move on here. The pool itself -- the bottom of the pool is anywhere from 1.5 to 2 meters thick. My point here is even the calculated value is an order of magnitude less than the full thickness so putting all the

database together whether -- I apologize.

I took the rebar out because in essence it has even less penetration than the pipe does for the same kind of specific impulse. I could have put that in also as a low.

When you put in the total database, you come to the conclusion that it's going to be extremely difficult for dropping a cask the full height of the water pool to end up with something that's able to open up the backside of the pool even if it's not sitting on soil.

Some of these are sitting on either bedrock or soil. Others are elevated. This tells you, I think, that this concrete is very, very tough against these kind of impacts.

DR. KRESS: What contribution did the staff have for cask drops and draining the pool in their technical study? Was it significant enough to worry about?

MR. HENRY: It was significant enough to worry about.

MR. COLLINS: Two times 10 to the -7, the likelihood of a uncovery of the pool due to a cask drop, two times 10 to -7.

DR. WALLIS: Bob Henry is saying it's zero?

MR. HENRY: I've been accused of saying that in the past. I think what's really important when we do these risk studies is to make sure we represent the available technical basis. I would like to see this kind of information in there.

DR. WALLIS: What did the staff use for the mechanical probability with this scenario of the whole development with most of your risk number probability of the cask dropping at all?

MR. COLLINS: Most of the number was the probability of the cask dropping at all.

DR. WALLIS: If it did drop, you're assuming it went through the bottom?

MR. COLLINS: No.

MS. HENDRICKS: It was factor 1.

MR. COLLINS: No, it was not. It was 1 in 10.

MS. HENDRICKS: One in 10 was for the wall. It was a factor of 1 if it hits the floor.

DR. WALLIS: So you and Bob disagree on the maximum amount possible. You say it's 1 and he says it's zero.

CHAIRMAN APOSTOLAKIS: So what's the factor of 1 in 10?

MS. HENDRICKS: It's .1 if the cask is

presumed to hit the wall and it's a factor of 1 probability of failure if it hits the pool floor. At least that's what in the appendix.

DR. KRESS: So you're saying instead of this being 2 times 10 to -7 it ought to be 2 times 7 -8?

CHAIRMAN APOSTOLAKIS: Neglectfully small.

DR. WALLIS: It ought to be 2 to -14 or something like that.

MR. HENRY: I would say the conditional probability ought to be less than 1 in 100 for sure.

CHAIRMAN APOSTOLAKIS: Because in this analysis that you have done something that might be wrong or why not zero?

MR. HENRY: Every time I used zero in the past you guys jumped all over me.

CHAIRMAN APOSTOLAKIS: That's the fun in it. If I look at this and I don't have any other information, I would say zero. Why shouldn't I say zero?

MR. HENRY: I would say zero.

DR. KRESS: But that doesn't change anything because it was already low enough that they didn't have to worry about it.

MR. HENRY: There's a couple things. I won't speak for the conclusion of the study but I will

say in writing the study that cask drop failing the spent fuel pool shows up a number of times as a way that you could rapidly drain the pool.

DR. KRESS: Okay. It's a perception.

MR. HENRY: Plus the fact I would like to see these things referenced so that we know the database that is used in the physical part as well as the probability part has got a good strong foundation.

CHAIRMAN APOSTOLAKIS: So it's a matter of confidence.

MR. HENRY: Yeah.

MS. HENDRICKS: I think what it also does, too, is you end up going from it's dominated by seismic to it's only seismic. I think that makes you want to look a little more closely at what you're doing to the seismic.

CHAIRMAN APOSTOLAKIS: I'm a bit confused now. Dana, you keep telling us there is this table where seismic appears as --

DR. POWERS: I showed the committee the table.

CHAIRMAN APOSTOLAKIS: Yeah, I remember that so why is it only seismic?

DR. KRESS: I don't remember the source but it came out of AEOD.

DR. POWERS: The table was given to me. It was repeated to be part of the staff study.

DR. KRESS: I don't know what that means.

DR. POWERS: It was part of the staff study and it got corrected later or it was part of the staff study and nobody believed it or what, but clearly it would be erroneous to say that it is only seismic.

CHAIRMAN APOSTOLAKIS: If the table is correct.

DR. POWERS: No, no, no. I don't have to say if the table is correct. I don't have to put that codicil in because there are clearly things that cause pools and concrete things to fail other than seismic event. There are clearly drain-down events that occur. They are just small compared to the seismic is what the staff is saying.

MS. HENDRICKS: E to the -8 to E to the -9 if you go through the report. The question is whether you keep adding up a lot of small numbers.

DR. POWERS: You can add either the -9 for a long time before you get any change of probability here. I mean --

DR. KRESS: I can buy the argument for the need to be consistent and have the right perceptions and important stuff even though it probably doesn't

make any difference to the bottom line on how you write the rule. I think there is some value in having a technically sound argument.

DR. POWERS: One of the things is you would have to worry about it seems to me in thinking about these pools is they thermally cycle and they are going to thermally cycle a lot during recommissioning.

If you don't have stress relief for that, then we're cycling concrete dose fatigue. If you do, then you have to worry about compression of the stress release on them. I mean, there are lots of things you can worry about.

DR. KRESS: Thermally cycled because of the outside temperature change?

DR. POWERS: Yeah. Actually, it's not the outside temperatures. It's the ground temperature that's going up and down.

DR. WALLIS: Bob, did you do the seismic calculation too?

MR. HENRY: No.

DR. WALLIS: I'm kind of intrigued about the mechanism of failure under seismic loads of such a massive concrete.

MR. HENRY: No, I didn't.

DR. WALLIS: You can shake a big mass of

concrete quite a bit without busting it.

DR. POWERS: You can look at the news pictures of the concrete abutments from the 1994 earthquake and see it doesn't take much to bust up concrete.

DR. WALLIS: It depends what it's connected to and a lot of things.

MR. HENRY: One of the things I should mention here that I didn't is in all these things I didn't credit the liner strength which obviously all the new pools have a significant liner on the bottom.

Last time we were here we talked a little bit about fission product release so I won't belabor this point.

DR. POWERS: I wish you would belabor it enough to tell me why you didn't put the Chernobyl incident on your list here. And explain to me a little bit why we got so much ruthenium release so early in the Chernobyl accident.

MR. HENRY: Which was metallic.

DR. POWERS: Say again?

MR. HENRY: Which was metallic.

DR. POWERS: It was metallic afterwards. The release itself almost surely had to be as a oxide. There's just no way to do it any other way. By your

own calculation the vapor pressure is diddly squat at temperatures two times what Chernobyl ever had.

MR. HENRY: Yeah, but the temperature of the fuel at the time of the actual --

DR. POWERS: Even at that, Bob --

MR. HENRY: It's pretty hot.

DR. POWERS: If we had, we would have been boiling U02. I mean U02 will boil off before your ruthenium will boil off.

MR. HENRY: One of the reasons I left Chernobyl off of here was just because of these I see as a lot more technically scrutable that we can get in and exactly better understand the releases and the relationship to zirc.

DR. POWERS: There is a little tiny test, Bob, that don't allow the zirc to go up to temperature, melt, and drain away.

MR. HENRY: I'm aware of that. I'm not saying these are the final answers. I'm only saying these are an important part of the technical basis.

DR. POWERS: Things can happen.

MR. HENRY: These type of things can happen. It's just the rate at which it happens. As you know, nobody really knows what the temperature was of the fuel observed at the Chernobyl event.

Plus the fact that nobody is still quite sure what the initial event actually looked like in terms of how it was released because obviously there's an explosion. It's a nuclear explosion and that also scattered the fuel. All those things would influence the rate at which things could be released.

These hit home to the issue of having air there and steam which is an important part which is particularly this Oak Ridge test, VI-7, and the CANDU test because they tell us the relationship with these cases where we have oxidation ongoing over a long period of time, what's the role for competing of oxygen with all these reactive metals.

DR. POWERS: That's not even close. I mean, they are not even close. The reactive metal is so reactive it will suck the oxygen out of anything before you get to the ruthenium. I mean, I don't think that's an issue. I mean, I don't anybody doubts that ruthenium is an excellent getter.

MR. HENRY: Ruthenium or zirc?

DR. POWERS: I'm sorry, zirc is an excellent getter.

DR. WALLIS: Tell me about the melting of the cladding. Why doesn't the cladding flow?

MR. HENRY: I was going to get to that in a

second but certainly the upper part of the cladding in this kind of an event is the thing that oxidizes first. The more it oxidizes the stronger it gets in terms of these events because it has a higher melting temperature. The zirc oxide could sit around for a much longer time and even support the zirc on the inside.

DR. KRESS: Yeah, but it's apparently brittle.

MR. HENRY: It is.

DR. KRESS: It cracks.

MR. HENRY: If you give it any kind of --

DR. POWERS: You want to be careful about drawing experiences from steam because you get a much higher energy input for unit of oxygen reacted and you get a much less compact oxide.

MR. HENRY: I understand. Realize this is steam and air in this.

DR. POWERS: A little bit of air wins the battle every time because it's the nitrogen component that is causing the problem.

MR. HENRY: I understand.

DR. POWERS: It doesn't take much.

MR. HENRY: My only point here was we finally get back to analyzing it in a pool especially

for those systems that are only partially boiled down so you've got a "blockage" at the bottom.

That's also steam and air because you've now cut off your air supply except for whatever small kind of curve flow you have from the top. That's why I put both of these on here. I think they are very relevant to the database and they are in the report that the staff wrote. They didn't forget about these.

Our only point here is that we think it would be very helpful instead of -- I shouldn't say instead of -- in addition to the two boundaries that they have for what the ruthenium release would be let's use this information and also put a third curve on that gives a best estimate.

When people look at these two boundaries they have some idea of these two orders of magnitude, whereabouts we think things are most likely to be.

DR. KRESS: It generally takes a lot of data to get a best estimate. I'm not so sure we have enough data to call anything a best estimate.

MR. HENRY: I would always use the data for something because that's what you know. The bounding parts you've kind of more or less pitched in and said it's got to be between zero and 1. I realize that, Tom, and that's why the two things we're going to come

down to.

First off, these are recommendations. And, more importantly, we think this would be a study that should have a peer review because it's not my opinion and it's not any individual opinion around here. We ought to make sure that what's known in the technical community gets shown in this report.

DR. POWERS: I guess what I'm struggling with is you're saying let's use these data for a best estimate. I think what you're saying -- I think I may agree with you.

MR. HENRY: It's time to go home.

DR. POWERS: That what you're saying is that the staff merely needs to model the dynamics of the clad because the data show that dynamics is of overwhelming importance.

If it's there and it can oxidize, you not only are not going to get any ruthenium release, you're not going to get a decrepitation release. If it's not there, then you've got another problem so you have to mode the dynamics of the clad. That's the best estimate you're talking about.

MR. HENRY: In essence, yeah.

DR. POWERS: Okay. I'll go along with that. I mean, you can't argue with that.

DR. KRESS: I can't argue with that either. Clad dynamics is a very tough problem.

DR. POWERS: It will attract your attention, yeah. On the other hand --

DR. KRESS: I wouldn't mind doing some experiments.

DR. POWERS: Well, on the other hand, I think you may have the experimental base to do it because they did a test in which they put enough specific energy input into them to get the clad to flow between the two oxide crust, one on the outside and one between it and the fuel so that you would have enough information to give yourself a criterion for when the clad would flow down those things.

You probably would struggle with when the clad would rupture and allow flow but, for an unruptured case, I think the data exist.

MR. HENRY: A lot of things I think the clad does that is shown on here and certainly the geometry is influenced by the details of the pool, whether they have boroflex or bural for PWR systems or nothing at all. They just chose to control it with borax acid. Obviously, for BWRs fuel assembly cans.

If you get to this issue of where the system is partially drained down, it begins to look, except

for the decay power and the fact of atmospheric pressure the whole time, just like the kind of analyses that have been done for large break LOCAs for BWR systems.

You can go do that calculation to see just how much oxidation you're going to get with that because it's being limited by how much water you have in there. You get in the range of 10 or 15 percent and from then on it's just accumulating molten metal. Obviously where that goes is down to the bottom of the pool and after a long period of time you start having concrete attack, etc.

But the cladding itself controls how the material begins to relocate because the first part that melts is actually inside the cladding because, as Tom said, the zirc oxide could be brittle but unless you give it some kind of a privation, the molten material drains down in the inside of that Zr02 to begin with and it starts dissolving U02.

All those things are relatively complicated but what they tend to do is give you melt relocations and start blocking everything off. Especially when it finally breaks through the cladding there's a lot more molten material to go out than just the cladding by itself.

All those things are part of what you have to be concerned with if you go to detailed representation. But I believe if you look through the various things that have been done. Dana just discussed the CODEX experiments. That's part of the technical basis.

TMI is part of the technical basis. It's not exactly what we're talking about here but it has all the issues related to cladding dynamics and melt relocation and even having the potential for some of the fuel to be declad from the top part of the fuel assemblies that's left on top of the debris.

These tests we just talked about certainly you need to consider the fact that there can be a small fraction of the material left on top of the debris and that should also be assessed in terms of it's temperature because it by itself is hard for it to get very hot because it is cooling.

Unless the debris bed gets real deep it's cooling by radiation. That has a very long -- if you keep temperatures below 1,000 Kelvin it takes quite awhile to release the material. Those are only recommendations for expanding the technical basis.

DR. POWERS: Would you go over that debris bed a bit for me? I just didn't follow you. I mean,

debris beds get hot pretty easily actually.

MR. HENRY: Debris beds can get hot pretty easily depending upon their decay power. Of course, we are dealing with things that are fairly small here.

If this material that collapses down and accumulates a continuous mass and it's having a hard time getting energy out of it, which it will, then all the particulates sitting on top isn't receiving much from below and it's only going to reach a temperature that it by itself is able to power.

You have circulation through that bed and you have radiation off the surface. An example, 10 percent of the material is going to cool very effectively in the range of about 950K.

You can translate that back to what the rate of release is that you again get from experiments that have unclad fuel. That's a very slow release rate given from ruthenium exposed to the air.

DR. POWERS: 1,000 degrees?

MR. HENRY: 950K.

DR. POWERS: You might want to go back and look at the Oak Ridge disk. Their top temperature in their test series was 950, I believe, and they got quantitative release.

MR. HENRY: You mean this Oak Ridge test

here, VI-7?

DR. POWERS: No, no, the Lorentz tests that were done back in the '60s. They ran a series of tests that -- Tom, correct me if I'm wrong -- 450, 650, 750, 850, 950 and the 950 they got quantitative release in less than 20 minutes.

DR. KRESS: That meets my recollection also.

DR. POWERS: They also got the tellurium and a couple of other things were high at that temperature. I can't remember what they were but nothing is important except the ruthenium and the decrepitation release.

Ah, that's a point. At that temperature they did not get decrepitation release at that temperature because the U308 that was forming was centering almost as fast as it was spalling.

DR. KRESS: Decrepitation happened at lower temperatures.

DR. POWERS: Yeah, they got decrepitation at low temperatures but not at high temperatures.

DR. WALLIS: Dana, I think you should keep all these results up your sleeve and have him do his analysis and then see if it works.

DR. POWERS: He just has to do the Chernobyl calculation.

DR. WALLIS: I know but I'm just suggesting that to verify or validate his approach.

DR. POWERS: I'm going to give him every parameter in the world that he can adjust. He can adjust the flow rate through it. He can adjust the temperatures.

I mean, I'm giving you all kinds of fudge factors here, Bob. Just calculate Chernobyl for me.

MR. HENRY: I'll be happy to go back and look at Lorentz' data. I based mine on the data that the Canadian people did. That's all why we should have some kind of peer review here to make sure that not only is the database known but used in a consistent manner.

In conclusion, the evaluations for the cask drop event we think should incorporate this database which is significant, which is full scale. It also takes advantage of things that are done with very high specific loadings.

We think that if you use that quantitative approach, in essence that one is virtually impossible or zero, George, because, again, that's why you have a peer review, to make sure you get a cross section of opinions.

I think you could take that one off of the

list. We think the risk that is shown in here should also represent a third curve -- should include a third curve to give some idea of what we think the best estimate is because we did these experiments.

While we may not have the kind of database there we have with other parts of the analytical spectrum, it sure would be nice to give some perspective in the integral sense what this really means.

Lastly, we think that things like this, that peer review cuts across the board of both industry and academia as well as the regulator is essential because then we make sure that whatever the technical basis is gets surfaced, gets at least reported so people know what is sitting out there they can use to make some of these decisions.

DR. KRESS: Let me ask you about the second conclusion. The technical study did use a relatively high ruthenium releases. Yet, they found the risk to be acceptable. Why should they go any further if they already have acceptable risk?

MR. HENRY: A lot of it is the perspective that comes from it. Then there is also some conclusions drawn in the back about what that means in terms of issues related to EP and others as well and

that comes from those studies where the risk is acceptable.

DR. KRESS: Do you think there are other considerations that might come into play eventually because ruthenium has melted and land contamination might be an issue if you use these bounding calculations as opposed to best estimate?

MR. HENRY: I guess I'll beg on that one until I knew exactly how they were going to be used in the land contamination evaluations. I mean, it's hard to compete with cesium in contamination.

DR. KRESS: I agree with you.

MR. HENRY: After five years ruthenium is not much of an issue.

DR. KRESS: I agree.

MR. HENRY: Some of these pools are pretty full.

DR. KRESS: If the risk was already found to be acceptable, I was wondering if you thought maybe when they get down to plant specific considerations that they might find some that weren't acceptable by the bounding calculations. Therefore, you might need this best estimate as a basis for specific plants.

MR. HENRY: Lynette probably wants to say a few things about this. I think the best estimate also

gives you a good idea of where you need to focus your attention in the future as you do come across other issues. That's why we would really like to see it.

MS. HENDRICKS: I would like to pick up there. By definition, if you have studies out on different aspects of the plant operation and one is a bounding estimate and the other is a best estimate, in doing your plant PRAs and all this stuff how are you going to treat this risk?

There's no basis other than best estimate or mean estimate with the understanding of the uncertainty to apply this in a risk informed situation. I think you are going to be hard pressed to do that. Yet, it's on the books as something that is by its bounding nature implies a lot of risk. I think the best estimate is really critical.

Another reason it's really critical is because, and this was actually captured in the study, when you say the risk is acceptable, they actually went so far as to say, "We're not thinking about saying that you need a containment for the spent fuel pool."

That is different than asking those questions about do you need EP financial protection. Those questions, I think, you may need to look more to

what is a negligible risk. For that, again, you need a best estimate. That is the tool the commission needs.

Ultimately it will be a policy call because there is no magic number associated with financial protection or EP. But certainly a best estimate would allow them in a more absolute sense to say, "Okay, we have EP over here for the plant and should we determine on the basis if this risk is somewhat negligible compared to this that we can justify terminating those requirements."

Although the staff mentioned the stuff is intended to be broader than just looking at those requirements, the gist of the study was to address three ongoing rule makings for these requirements. The reason those rule makings are predominate is this is the only opportunity to save money or conversely to spend a lot of money unnecessarily in the decommissioning phase.

DR. KRESS: When people say best estimate, I'm never quite sure what they mean. I'm wondering if you could tell me what you mean by best estimate?

MS. HENDRICKS: What the safety goal says is you use mean values with a clear understanding of what the uncertainty is.

DR. KRESS: So a best estimate is a full distribution because in order to get a mean you have to have a distribution. Sounds like a tough job to get a best estimate for this particular issue.

DR. WALLIS: Could we put this in some perspective? We heard from the staff that no further physical chemical studies are needed because the risk is so low anyway. What's to be gained by learning anymore about this phenomena?

MS. HENDRICKS: I think what's to be gained is the commission has to make harder decisions. You know, is it safe enough compared to the safety goals.

Obviously it is but the harder decisions to make are do you need the extra protection, expensive protection, very expensive especially if it goes on forever because you can't determine a configuration at which point you can determine a heat removal that would imply that you don't need to worry anymore.

Twenty years or so of EP and financial protection are going to be grossly expensive compared to how we look at funding for decommissioning today.

DR. WALLIS: So you're worried about the EP cost and sort of custodial cost. You would like to just leave the thing after a while?

MS. HENDRICKS: You don't leave it.

DR. WALLIS: Close it up or something.

MS. HENDRICKS: You don't leave it. There are still people there.

DR. WALLIS: Not so many people.

MS. HENDRICKS: Stuff to be done. We have an operator on site 24 hours a day with nothing to do but focus on this pool.

DR. WALLIS: It must be the most boring job in the world.

MS. HENDRICKS: Well, it may be boring.

DR. KRESS: But you don't feel you could make those reductions and requirements on the basis of risk alone?

MS. HENDRICKS: Not with the bounding estimate. Another thing that concerns me about the bounding nature of the study was we talked about what will it mean. Okay, it's bounding because we just couldn't do much better with all the conservatism stacked up on a generic basis, but we imply that we can do more on a plant specific basis.

But if it's done within the constraints of the study, you're not going to get a different answer. You're going to have it driven by seismic. You're not going to be able to predict the configuration and you are going to assume maybe avaticia conditions. I

don't see much relief going from this bounding to a sight specific, unless I'm misunderstanding the way the study is put together.

Do we have time to talk a little about seismic?

CHAIRMAN APOSTOLAKIS: There's 10 minutes left.

DR. KRESS: Ten minutes.

MS. HENDRICKS: Given the depth of my understanding of seismicity, I don't think we have to worry about this going too long.

This is a curve that we shared at the commission briefing that shows the distribution of the risk by peak ground acceleration. I'm going to flip a couple up here quickly just to show that --

CHAIRMAN APOSTOLAKIS: What is this figure now? Let's understand the figure. If you put it up there, you have to understand it. You have the peak ground acceleration on the horizontal axis. The percent contribution. What does that mean?

MS. HENDRICKS: The percent contribution at the different seismic bands of damage to the pool. This represents convuling the hazard of the pool fracturing on top of the seismic hazard on a plant specific basis.

CHAIRMAN APOSTOLAKIS: This is conditional on this peak ground acceleration so given that I have, say, .9G, right? Or .8G, I go up and I see that there is the probability of .2 of causing damage. That's what that means.

MS. HENDRICKS: I don't know that it can be interpreted that way. It's a percent of the total contribution. It's more a way to show a distribution. What percent of the seismic failure.

CHAIRMAN APOSTOLAKIS: It says condition to spent fuel pool structure or failure probability. That's what it says.

DR. WALLIS: There must be a frequency in there somewhere because you would expect 2G to be more effective than 1G.

MS. HENDRICKS: Well, the probability goes down.

DR. WALLIS: That's right so probability is in this, too.

MS. HENDRICKS: Right. Yeah. When you convulve the risk on top of the seismic hazard.

CHAIRMAN APOSTOLAKIS: On the horizonal axis you count accelerations.

MS. HENDRICKS: Right.

CHAIRMAN APOSTOLAKIS: Not frequency. This

is .8G, for example. If I go to the left, this is a percent contribution to failure of the pool. That's what it says.

MS. HENDRICKS: Right.

CHAIRMAN APOSTOLAKIS: So 20 percent of the failures are due to .8G. Is that what it means? Then I have to multiply by the frequency of .8G to get the absolute frequency of the damage. That's the way I understand it.

MS. HENDRICKS: No, that's already in there. You took the hazard curve where you've already convulved the risk of failure on top of the probability of the event as well as the magnitude of the event. This is just taking that curve and parceling it out to show you the distribution.

I think Gary Hollihan's comment on this was it's not surprising. You have a very robust structure that even though the frequency of the seismic events are larger, the probability of failure is small.

CHAIRMAN APOSTOLAKIS: So let me rephrase it then to make it consistent with what you said. .8G and I go up and find .2. .2 times 1.4 to the -6 will give me the failure frequency of the pool that's caused by a .8G acceleration. It's unconditional, right? It's unconditional. It says it includes the

frequency of .8G. Who came up with this diagram?

MS. HENDRICKS: Our EPRI seismic experts did. I was looking for a way. We all say --

CHAIRMAN APOSTOLAKIS: A way to confuse us.

MS. HENDRICKS: No, no, no. We all agree it's all driven by uncertainty and that we just go on and use the curve. I think this will help you understand what it means when you use that curve. I'll show you the other soon or you can just flip.

DR. SHACK: this is basically telling us that most of the risk is coming from this far tail with the big acceleration.

MS. HENDRICKS: Right. The median is in excess of -- the median is at 1G so more than half this risk that we're applying. The question obviously is does this make sense.

CHAIRMAN APOSTOLAKIS: It's the same with reactors. I mean, the seismic contribution comes from accelerations of three or four times a safe shutdown earthquake which is what you're saying here. The safe shutdown earthquake is .15G and you're stuck seeing the significant import from .5 and so on. It's consistent I think.

MS. HENDRICKS: It's consistent to a point. It's consistent to a point. What makes this different

and in some cases worse is just to look at damage for this very rigorous structure we extended the curves. The Livermore and EPRI curves that we use for plants stop at a lower return frequency. They stop at, I think, 10,000 years. We specifically took this out to a million years which is going to influence the results.

The rest of the curves, as you can see, you get the same basis distribution and the same basic conclusions which are that --

DR. WALLIS: This structural failure problem, doesn't this thing leak before it breaks?

MS. HENDRICKS: This is looking for a catastrophic failure because leaks you can replace. Then you get your human error.

DR. WALLIS: Doesn't it leak? Even after an earthquake it's full of rebar. Doesn't it just leak in a few places? It doesn't just fall apart.

DR. SHACK: I think it's a question of whether it leaks or it leaks like a sieve.

DR. WALLIS: That's got to come into the analysis.

CHAIRMAN APOSTOLAKIS: I think we understand it now.

MS. HENDRICKS: Okay. So the point is the

mean is about 1G. At this level between about .5 and .7 if you go to the next curve is where you pull off at least for surry. We'll go surry to surry numbers.

What this curve shows is that at the 50 percentile to get into this range where you get into the real risk contribution between here and here, the frequency is about E to the -6.

You are really reaching out to grab very improbable events. You may do it in the context of reactors but it isn't going to have the same effect. I think you need to ask questions about how appropriate it is to do here and potentially in other areas of regulatory space where it's going to be the sole contributor.

Are you going to drive all protection requirements, all costs based on this seismic event? It will be the issue for passive plant designs and it could be the issue for the new plant design.

CHAIRMAN APOSTOLAKIS: I guess I don't understand quite what the issue is.

MS. HENDRICKS: The issue is --

DR. KRESS: The issue seems to me is you don't believe the seismic hazard risk.

CHAIRMAN APOSTOLAKIS: Why not?

DR. KRESS: I don't know. I mean, that's

what --

CHAIRMAN APOSTOLAKIS: The issue is you don't want to use it.

DR. POWERS: I would say that she absolutely believes the seismic hazard risk studies. She thinks that they tell you that this is something beyond the pale.

MS. HENDRICKS: Exactly.

DR. POWERS: I understand. Can I ask you a question about your slide?

MS. HENDRICKS: Sure.

DR. POWERS: Which really has nothing to do at all with spent fuel pools.

MS. HENDRICKS: No, it has everything to do with spent fuel pools.

DR. POWERS: The figure does but the question doesn't.

MS. HENDRICKS: Oh, right.

DR. POWERS: The question is you plotted the 15th and 85th percentiles. About the mean, why those particular ones? There's nothing devious about the question.

MS. HENDRICKS: Right. I don't know. It wasn't the 5th and 95th.

DR. POWERS: Those are just numbers you had.

MS. HENDRICKS: That's what was provided.

DR. POWERS: Nothing devious.

MS. HENDRICKS: No. I know you're not devious.

CHAIRMAN APOSTOLAKIS: Aren't you saying though --

MS. HENDRICKS: I would never say that.

CHAIRMAN APOSTOLAKIS: Is this the -- I mean, are you expressing different words the old argument that if I have designed a thing against .15G SSE, and I see that my damage occurs four times that, three times high earthquake, I shouldn't just do anything and just say it's good enough.

Is that what really you're saying which is the argument that why to use a PRA. PRA doesn't recognize this design basis thing and just goes all the way until it fails the thing and what really matters is the frequency. Is that the same argument you're bringing up?

MS. HENDRICKS: It's real close but I think what I'm trying to say is part of doing PRAs is understanding the uncertainty when you understand that the uncertainty is really completely driving you.

Another thing I wanted to point out on this curve, and I don't have it marked, but if you look at

the delta or the decrease in probability of occurrence between .1 and .3 because the air bands are fairly narrow, you get a factor of 10 decrease.

Between .3 and .6 because your bands are diverging, you have to go that much further to get a factor of 10. And to go from .6 to 1 you don't get a factor of 10. You get a factor of 5 decrease in the probability of exceedence.

What that tells you is even if you were to say it makes sense to design at these higher levels, you wouldn't even get credit for it in the uncertainty. It makes you ask what basis is that for doing what this agency is supposed to be doing which is determining what is appropriate to apply in terms of additional requirements.

If you're looking at a curve that wouldn't give you any credit for extreme redesign of your plant, does that really seem like a logical basis to regulate with?

CHAIRMAN APOSTOLAKIS: Well, I don't understand this credit business. I mean, the frequency of occurrence of this acceleration would not go down significantly but you would certainly get a hell of a lot of credit because you have built a stronger facility. This is not the probability of

failure. It's just the frequency of exceedence of the acceleration which is modern nature. I think we are getting into a debate here.

MS. HENDRICKS: Yeah. Yeah. I think --

CHAIRMAN APOSTOLAKIS: Your point that we should really understand better the details are going to the analysis is well taken. Beyond that maybe we shouldn't debate it more.

MS. HENDRICKS: Okay. Well, let me kind of close out here.

CHAIRMAN APOSTOLAKIS: Okay.

MS. HENDRICKS: I think the way the study progressed is nobody completely ignored this phenomena. They came up with a number for the seismic. They said seismic predominates. Very, very conservatively is 3 or 2E to the -6.

Everybody recognized that was highly conservative because of the conservatism in this and the conservatism in the furgility estimates. They even went so far, the experts, to say the risk is acceptable and it's much lower probably than E to the -6.

I think it begs a fundamental question if it gets that close to negligible, does it make sense from a public communication point to go ahead and do the

math. You know, risk times consequence and show these health effects.

I mean, we say that negligible probability is in the E to the -7 range and we are probably very close and we have qualifiers and we have the ability to show significant capacity beyond earthquakes that would even be expected on the east coast.

I mean, it seems -- and what I'm leading to is the question has come up in discussions with the staff and it came up in discussions with the commission of, well, then should we go back since we have this process and resolve the differences between the EPRI and the Livermore curves.

I think there is even a more fundamental question here of how to treat seismic risk than just can we bring the experts together and get them to agree.

CHAIRMAN APOSTOLAKIS: The difference between Livermore and EPRI is not that great anymore. I understand Livermore updated their curves in 1993.

MS. HENDRICKS: But it makes for good agreement in areas where you expect earthquakes but the tails diverge significantly. For the spent fuel pool study it made a factor of 10 difference which is only a factor of 3 if you look at cask drop but if you

take cask drop out, you're back to --

DR. SHACK: And your last slide says we should just truncate these suckers.

MS. HENDRICKS: I think there should be some consideration of truncating. There should also be consideration to come up with analysis which looks more deterministic.

DR. POWERS: If my objective is solely to look at the bottom line risk in these things, I think I agree with you since you're trying to communicate to people. Taking outlandishly high numbers and then claiming very low probabilities to them is probably not really communicating. I mean, taking an infinitesimal probability with a big high spike doesn't communicate.

If, on the other hand, I was doing this to say, now, what kinds of things should I be doing and what things have risk achievement worth and risk reduction worth, then don't I want to go ahead and do this?

MS. HENDRICKS: You may want to do it for that reason. I think NUREG 1150 did it for large seismic events. They looked at core damage frequency but they showed some restrain and didn't go ahead and do the multiplication to show these consequences. The

maddening thing about --

DR. POWERS: It was a lack of money. I know those guys.

MS. HENDRICKS: They're cheap.

DR. POWERS: No, their sponsors are cheap. They're profligate.

CHAIRMAN APOSTOLAKIS: Who is communicating with whom here when we say communication?

MS. HENDRICKS: With the public. With the public. When you go --

CHAIRMAN APOSTOLAKIS: This agency is supposed to be doing good technical work so, I mean, they have to communicate it to the public. I don't know what else can they do.

MS. HENDRICKS: I think it's inflammatory to take events of very, very low probability and multiply times consequences.

DR. KRESS: I don't understand that. That's what risk is, frequency times consequence.

DR. POWERS: Yeah, Tom, but let's be practical. I'm very sympathetic to this point of view. If you come out and tell me there is a probability that 100,000 people are going to die in Russia as a result of the Chernobyl accident, that gets the headlines.

Now, the fact that the probability is 10 to the -8 somehow doesn't ever make the headlines or anybody's reading. If it was just the headlines, I would probably say that's not the only thing the public --

DR. KRESS: But I don't want to cook the numbers.

DR. POWERS: I think she has a good sound point here depending on what you're going to do. If what you're going to do is look at the risk for this pool, then I think truncation has its merits.

If I'm going to do it to then derive something from the risks based on differentiating them, risk achievement and risk reduction worth, should I have a guy come by and check the pool once a week, once a month, once a year, that kind of question, then I think you shouldn't truncate it.

CHAIRMAN APOSTOLAKIS: Anyway, I wouldn't want the staff to come here and tell us we did this calculation but it would scare the public so we're not going to tell you about it. I don't think that's where you're going but --

MS. HENDRICKS: At some point, though, we do that.

CHAIRMAN APOSTOLAKIS: That's nature.

MS. HENDRICKS: We don't do the multiplication. I mean, your number that you gave at the commission briefing, Dana, was 10 to the -7. Maybe there's a point where you don't do the multiplication, not that you deny the risk.

DR. POWERS: I think you've got good sound reason to pick that number because what did we do with the VANRs? (A) We don't put them in the PRAs and the reason we don't is 10 to the -7. Hence, we don't even put them in.

This "I don't want to scare the public" sort of argument has merits to it. I understand that sort of thing. I understand the purists. What I worry about is when we say there's a probability of 100,000 people dying in Chernobyl -- or the Ukraine because of the accident at Chernobyl, even though that's 10 to the -8 probability, it does provoke people to do things.

We get massive studies of radiation effects that can't possibly ever yield a useful number because of the background chance of deaths but they are in response to these kind of flamboyant numbers. I appreciate the point that's being made.

MS. HENDRICKS: I think, too, to look at it from the reverse perspective, it's inflammatory, one,

but then also I think it sets up an expectation of a level of protection that's unreasonable. I mean, are you telling the public that they should expect the next facilities to be built and to withstand --

CHAIRMAN APOSTOLAKIS: No. I don't.

DR. WALLIS: It's like asteroid collisions.

MS. HENDRICKS: Exactly. Everybody knows about the big asteroid in the back of their mind but if we did the numbers and showed how many people were going to die, you may end up in a situation where people would demand research into how to protect us from the asteroid.

DR. WALLIS: And it will happen twice in the age of the earth.

MS. HENDRICKS: As a result, money would be taken away from our real risks in things that we can more readily mitigate.

CHAIRMAN APOSTOLAKIS: This is a much bigger issue than can be resolved in the next few minutes. Are there any other comments you would like to make?

MS. HENDRICKS: We always end up on the same note. Peer review. Maybe we could do some sort of a peer review on the seismic. I'm not sure it's the seismic experts because I don't think these curves will ever change but maybe they shouldn't but peer

review about the appropriate use.

DR. POWERS: You know, I guess I realize you are kind of insulting the committee. We were asked to do a technical review and apparently what we did was inadequate, I guess, in your mind, but we are not peers. I mean, some of us think -- at least one of us thinks he's a lord.

CHAIRMAN APOSTOLAKIS: I don't think we should get into that. Any other comments?

DR. POWERS: How much more peer review do you want?

CHAIRMAN APOSTOLAKIS: The commission has a history of establishing external peer review. When they did the 1150 review they did not intend to insult the ACRS so I don't know why -- in this particular case if they want to have a peer review, they want to have a peer review. I mean, if they weren't happy with an ACRS review, they wouldn't probably ask for it.

MS. HENDRICKS: Nor does ACRS have the resources to look at -- I mean, this study portrayed many questions that would take a lot of resources to complete.

CHAIRMAN APOSTOLAKIS: Any other comments from the staff? The public? Thank you very much.

MS. HENDRICKS: Thank you.

CHAIRMAN APOSTOLAKIS: We'll recess until 2:45.

(Whereupon, at 2:26 p.m. off the record until 2:46 p.m.).

CHAIRMAN APOSTOLAKIS: The next subject is Management Directive 6.4 Associated with the Revised Generic Issue Process. Dr. Kress again.

DR. KRESS: I'm busy today.

CHAIRMAN APOSTOLAKIS: Boy. Go ahead.

DR. KRESS: Well, just to remind the committee, the ACRS has had misgivings about the whole generic issue process for some time and had expressed it in a series of letters. The staff decided to look at the GSI process and see how to make it better, I guess.

They came to us back in '99 with the revised GSI process. As far as I can tell from reading your letters and my recollection is we liked what we heard. It sounded like a comprehensive way to do it and an improved way. I think what we asked was could they go out and do a pilot assessment of it and tell us how it worked in practice.

I think that's what they did and today I think we're supposed to hear about the results of that

pilot assessment. I'll turn it over to Harold VanderMolen, I guess.

MR. VANDERMOLEN: Thank you, Dr. Kress. My name is Harold Vandermolen. I have sometimes the dubious distinction of being manager of the generic issue program. On my left is Mr. Ronald Lloyd who is our person in charge of management directive 6.4.

Yes, we're going to tell you about our experiences with the trial application of the draft management directive.

MR. LLOYD: Our first slide kind of recaps some of the things that Dr. Kress has alluded to. We initially had a draft version of 6.4 that was issued back in early '99. We had an ACRS presentation at that time talking about what was in that particular document.

We did go through it by the end of July as is shown on the slide. We actually produced an entire version of management directive 6.4. There was a very minor change to it that was proposed by OGC to add in some lawyerese to the document on October 21 of '99. Then we are here today, March 1, to provide some lessons learned on what we actually found and discovered as we tried this out on some reactor issues and also some material issues.

We also have a tentative schedule that will be on another slide. The purpose of our being here at this time is to seek approval to go through and update that management directive based on the lessons learned we have to date.

DR. KRESS: Are you looking for a letter from us then?

MR. LLOYD: We would be looking for a letter probably at your convenience in the April/May time period to tell us to proceed.

DR. KRESS: Okay.

MR. LLOYD: We'll go over that schedule which is on a slide further back in the presentation.

Our next slide, please.

The process that existed earlier was referred to as RES office letter No. 7. It basically had three different steps in it: Identification which was basically what is the issues. It had a prioritization phase where we would go through and do an assessment, a PRA type assessment.

We would then categorize so there's a high, medium, low or a drop situation. Then comes the resolution phase. I know this caused some problems in the past with ACRS, you know, what does resolution mean, what does resolve mean, and so on.

Beyond coming up with basically an available solution which was the resolution phase of the old procedure, nothing was really procedurized which was one of the concerns, I believe, of several people.

The draft management directive, as you can see on the left side of the table, currently has eight stages to it which takes it through from the very beginning to complete close out which is proceduralized to verify the corrective actions have been taken by licensees on some sort of audit basis and a closeout inspection that would have to be documented to do that with several steps in between. To date we have experience of going through stage one, two, and three of the management directive.

Next slide, please.

The next one here shows the issues that we actually tried it out on. We had six candidate generic issues, three reactor, and three materials issues. The material issues we'll go through kind of briefly now and then we'll talk about the reactor ones on subsequent slides.

The material issues were basically all identified in the October 2000 time period. As you can see by the current status on the block to the right of that, these issues were received by the panel

and an in depth discussion as to what the issue really was and its risk significance and what should be done. We are subsequently dropped from any further review by the generic issue program in January and then again in February of 2001.

They were basically dropped because of a couple of reasons. They ended up being isolated cases, i.e., not generic, where their risk significance was lower, or there was already existing regulatory guidance that was sufficient to maintain whatever needed to be maintained as far as inspections and verification that things were being done appropriately.

MR. LEITCH: Were these dropped at step 2, that is, the initial screening level?

MR. LLOYD: Yes. That's correct.

Next slide.

MR. VANDERMOLEN: Now, we are going to speak about our experience with each of these issues in a moment. In addition to those six, we felt that we should have one issue that we sent to the old process just for comparison purposes for this use, generic issue 185 which had just come in.

The old process has been in place for about 20 years now and it has had over 800 issues processed

through it. Although it's been modified a few times, it has essentially been unchanged in all of that time.

It was one of the first uses of probabilistic risk techniques in agency decision making. We did not feel that we could really evaluate experience with the new process unless we had at least one that we sent through the process with some examination and oversight to be able to compare the two.

Now, getting into the specific issues, we'll start out with 186. Ron.

MR. LLOYD: 186 was one that I was personally involved in as far as gathering data and information. This was one that was proposed by NRR and they had worked it for some period of time. They figured that we needed -- they needed to have additional technical basis for making decisions so they wrote a letter and forwarded it over to research.

Then it came in a time period when we were just starting to work with management objective 6.4 so it got picked up under the new procedure. The panel met successfully. We had a very good panel that did get together. We had a couple of different meetings with the panel to discuss additional information. There are a few lessons learned out of that.

Initially when the panel looked at all the information and the data it was classified as a compliance issue and the recommendation would be that the issue should be dropped from any further processing through the generic issue program.

At that NRR requested that we actually do a risk significance and gather some operating data that they could use. It was decided we would continue on with the generic issue program and continue to process that issue.

After which time NRR then complained so much that too much time was being burnt up by their people coming to the panel meetings and so on and they actually didn't budget sufficient amount of time in their own budget for the entire year. Harold will talk about that a little bit later. These were some of the lessons learned that we came up with.

We actually ended up going out and visiting eight different facilities of different design types to get a good broad spectrum of what would be out there from a risk perspective. We hit all the various kinds of BWRs with different containment type designs. We also did different PWR designs by different NSSS ventures and so on.

DR. KRESS: Is there a record of drops that

end up in the LERs or somewhere?

MR. LLOYD: Yeah. What we did was we went through new docs and went back to the beginning of time and looked at all the different drops or problems that had been recorded some place, either by vendors themselves, crane vendors, licensees, inspection reports, where we could find them.

Then we went out and actually gathered data going back to the time that NUREG 0612 was generated which was 1980 which then required licensees to kind of beef up their crane program and come up with a lot of different sorts of procedural requirements and training requirements, electrical interlocks and so on to make them more reliable, I would guess.

We got that data and we extrapolated to the other different kind of design types and looked at the number of refueling outages that they had had and came up with a number of problems and also the number of lists that you had. We had a frequency of failure to start.

We've got some good data on that. That has been put into a couple of different databases and we expect to turn out a report on this probably within the next month or so. That's 186.

187 is one that Harold will cover.

MR. VANDERMOLEN: Yes, 187 is not as far along as 186. 186 has actually gone through initial screening and is into technical screening, the third stage of the process. The next two are newer and haven't gotten quite as far. 187 is nearing the end of initial screening.

This is one on cesium concentration. All of these are interesting in their own light technically but I would like to concentrate on the experience we had with the procedure.

We learned all the lessons that we learned in 186 and a few more. Difficulty encountered in arranging panel meetings. Well, what did we learn? What we learned was that the panel members that you really want are people who are very much in demand. It's not always easy to get their time. They are often already busy and booked up.

This contrast would be management directives requirement that we try and get initial screening done in 30 days. This particular one, one of the principals was called out to testify at an ASOB meeting right in the middle of that period and we were pretty well stuck. Not an impossible problem but it did mean a delay.

We also learned that it is very wise to give

guidance early in the process on how the panel is going to decide things. The management directive is silent on this but the question is should a panel come to its decision by unanimous consensus. Should it be by a majority vote? If you do go by majority vote, you have to talk about whether or not you are going to allow descending opinions to be written.

These are not new questions for this committee I'm sure. But in this particular case the panel decided right at the beginning that it would try and achieve the full consensus. Then what we discovered was that even if everyone agrees on the conclusion, it is possible to disagree on exactly how you are going to get there. We are still resolving this one, although we are pretty close to getting it out.

DR. KRESS: Suppose you had -- how many members are generally on the panel?

MR. VANDERMOLEN: Anywhere from six to -- what was the biggest one we had?

MR. LLOYD: Five to seven or eight. Something like that.

DR. KRESS: Suppose you had four of them that said drop the issue and two that said go on with it? Do you have a binary system that says pick the

highest, the most problematic one? That is, send it on and not drop it?

MR. VANDERMOLEN: Well, we really don't have an answer to that one yet. This is one of the things we have to resolve. There is always the oath that is administered to a jury here in Montgomery County.

If any of you live in this area, you may run into it, where the jury is sworn by the judge to keep the jury with neither meat nor drink until a decision is rendered. Fortunately, we're not too serious about it. Although, I am tempted on some days, I don't mind telling you.

We'll talk more about this when we come to our recommendations.

Next slide, generic issue 188, also in the initial screen stage. This is one on resonance vibrations of steam generator tubes following a main steam line break event.

Again, this is a very complex issue involving inspection of disciplines that wound up with a somewhat larger panel still. We had all the same difficulties of getting an expert panel together. Then when we got the panel together, the staff member who raised the issue was unavailable because he was involved in still other activities, some of them

involving the ACRS.

DR. KRESS: Is the issue that you might fail the steam generator tubes by these vibrations?

MR. VANDERMOLEN: Yes. That's exactly it. Strongly related to similar issues that I know you've been considering.

DR. KRESS: Yes.

MR. VANDERMOLEN: Also, the principal person that we wanted to talk to wound up having some significant medical problems at the time and was unavailable. We have to allow for these things.

One thing I should point out is when we started this issue and, again, I think people around here will be sympathetic to this, it is amazing how much briefing material you sometimes have to provide to committee members. This was a stack that was about six inches high.

What did we learn from the process? Obviously the panel preparation is not easy. Also we learned in the discussion that it was not easy to tie down the scope of the issue.

In any of these generic issues you have to at a very early stage just decide where the scope is and not change it once you start because otherwise you will never come to consensus. We went through all of

this on this issue.

Having said that, I want to make a few overall comments. When I say that there was difficulty in panel preparation, I did not mean that there was anything inadequate about the technical discussion of the panel.

What this translated into was that people had to spend a lot of time preparing for the meeting. I have to say having been on these panels and feeling a little skeptical when the whole thing started, the technical discussion that I observed was of extremely high quality.

I've been here for a while and I've been on a lot of committees and panels and things like that and I've observed many more. These were very professional. There was a lot of good discussion not only at the meetings but in between meetings as members would discover new facts or documents that were relevant.

They were sharing them with the entire panel by e-mail and so forth and people arrived at every meeting well prepared having read all the material. It was quite a good focused discussion.

DR. KRESS: Who selects these panels?

MR. VANDERMOLEN: We recommend panel members

to our management but ultimately the office director sings a memo after negotiating appropriately and actually nominating the members.

DR. KRESS: You picked the panel and their candidates by their expertise related to a specific --

MR. LLOYD: It could be based on their expertise and also be different depending on whether it was a reactor issue or a materials issue, whether Research would make that move or whether NMSS would make that move.

DR. KRESS: When you decide I would like to have this guy here, do you check with him to see if he's willing to serve?

MR. VANDERMOLEN: Yes. And we have to check with his boss, too. The management sometimes has strong opinions about this.

I should also say that we had some difficulty in this issue and some of the others. Once the people got going they were all set to go ahead and charge in and try and solve the issue. We had to keep it just on the purposes of the initial screening.

Next slide, Ron.

We also, as we mentioned, had an experience with the generic issue we processed under the old system. This is generic issue 185, control of

recuracality following small-break LOCAs and PWRs. Again, this is a rather complex technical issue requiring quite an in depth review.

Now, let me explain something here, the difference in procedures which is why we were doing this, of course. In the original procedure, the one that we've been using for 20 years, there is no initial screening panel. What happens is usually a single analyst here sits down and investigates and then writes up the issue doing a probabilistic analysis and puts a package together describing all the findings.

Then it goes out for a concurrence review. Now, concurrence is nothing new to anyone here but this is a little bit more than usual office concurrence. It does go through our management, yes, then the write up under the old procedure.

Parallel copies are sent. One copy is sent to whatever person or group originated the issue. This person may not agree with the analysis and usually gives it a pretty thorough looking over. Another copy goes to whoever, be it a single person or a group, usually group, is going to have to work to resolve the issue. That person may have very different opinions from the first one.

Thirdly, we would send one to an independent analyst, usually a PRA expert, just as a quality check on the work. And there may be more. If you have special technical areas we would try and get a review by an expert in whatever technical discipline was involved. They have all been collected together. The comments are resolved and then it goes back to the management review.

In this particular case the prioritization write up was completed in six rather intensive weeks. The concurrence review then lasted 197 days. I might add also that this is not 197 days of benign neglect. This is 197 days with gentle reminders, not so gentle reminders, sometimes more forceful reminders.

I was often reminded many years ago when I was in college and I worked in a public library and had to remind people, sometimes professors at a local university, that it was time to bring back the books. It's not always easy to get this.

Well, why did it take so long? We all agreed this was too long a period. Speaking to people in retrospect it was probably pretty obvious. This is a 20-page write up, one with a lot of meat in it, well marbled with figures, tables, drafts, and equations. It was not the sort of thing that you could just read

and pass on.

In fact, I think this is characteristic of any generic issue write up. It's usually not the sort of thing you can read a few pages one day and as time goes by the next day pick up a few and so on.

This is something where you have to set aside a few days and read it, ponder it, and understand it, which people wanted to do. They were very well motivated but these are busy people so in retrospect I can't say that it's that surprising. Clearly you've got to do better than this.

Moving on to materials issues which Ron will discuss.

MR. LEITCH: But if I'm reading the data correctly, it looks as though using the new system you would be pretty pleased with 197 days.

MR. VANDERMOLEN: These thoughts have gone through my mind. We'll talk about that in just a moment.

MR. LLOYD: The next slide, No. 9, has to do with the candidate materials that were presented through the materials area, NMSS. As I mentioned before, none of the candidate issues had specific comments as they went through each one of those issues but we did have some generic sorts of comments on the

process itself.

Recapping a little bit, going back to that table that was presented earlier on slide No. 4, each of the issues I thought NMSS did a really outstanding job. These were brought up in, like I said, October of 2000. There were panel meetings that came up very soon after that.

I think they were very well prepared. They looked through the issues and came to the appropriate conclusion, each of those being dropped because of situations that led them outside of the generic issue program.

The leaking pools which was the first one was initially a B&W issue with casks where they had radioactive material in it, where they had water that was leaking, and there didn't appear to be any regulatory requirement to go out and track water that was seeping out and measure the radioactivity and so on.

They found subsequent to that that this was an isolated case and the water never really got outside of the bounds where it would do any problem anyway so that one was eliminated.

The second one, unlikely events, I guess would be parallel. You would look at kind of a duel

train system and a reactor situation. The ANSI standard 8.1 allows them to take unlikely events and say, hey, that's not going to happen and that sort of fills the second train criteria.

Therefore, you don't have to worry about it. Inspections realized that even though certain licensees were taking advantage of this classification of unlikely events, they actually had failures in those systems where they were saying this was an unlikely event. This was the key that got them into maybe they had other problems and other sorts of situations where we have unlikely events and different licensees.

I looked at that one and that came back and it was determined that once again this was an isolated case. It was with the Portsmith gaseous diffusion plant that the issue was at.

There were some changes made that came out of that so there was a positive part of this. This was the subpart H of 10 CFR 70 that got changes. That was also a letter that was sent out to licensees reminding them they should look into these areas and fix those things.

The third one that was tracked through NMSS was the gammaknife. That's the gamma stereotactic

radio surgery. There were several misadministrations where they actually got the coordinates of where they wanted the dose distributed incorrectly. In some cases they got the two axis backwards.

Out of this rather than continuing on with the generic issue process and calling it a generic issue, they then processed it in a lower level format. It was IEN generated. It was 2000-22 which told all those types of licensees of the kinds of problems that were generated, the human errors that were generated, and so on.

This was an example of how the new procedure would tend to go. You would have a quick analysis of where's the risk and is it generic. Go through your panel and come to a consensus with the panel hopefully on whatever that decision would be.

If the answer is not let's process it as a generic issue but let's call it some other form of generic identification, then let's do it with the easiest possible pathway. That's what NMSS did here. It was done through the IEN or the genetic communications process.

Next slide, please. I have some positive things about the process itself. Several of these are kind of interrelated as you look down through the

bullets. Most of them have to do with saving staff resources at various stages of in the game.

The first one would be to save resources obviously for those issues that would be proposed that were of low risk that would never meet the thresholds. Therefore, why waste your time doing analysis if you've already got a very good idea from a group of experts that would say, "If we don't need to do that, we're smart enough to determine that we're not going to meet that threshold so let's drop the issue entirely or possibly go and do it under some other sort of a format like the generic communications process."

When you get down to the compliance issue, if you actually determined there was a compliance issue and you did some analysis on it, at least you would have some sort of a technical basis to give back to NRR or give back to NMSS or whoever is working the issue that would help them in that compliance arena.

NMSS felt that the formality of the process gave it visibility. At their meetings I was very impressed that their panel was quite large. There were a lot of people that attended the meeting, not only the panel people themselves but other people who were interested.

I think a lot of discussion took place at that time so there was a lot of visibility given to the process so they got some respect, I guess, is what we're saying here.

They also thought that the flexibility of the handbook, which is a guidance document, was written not to be a verbatim compliance document where you had to do step one, two, three in order and check off all the blocks. It is a guidance document.

They use it as a guidance document and took those things out of the handbook that best fit them in addressing the issue at hand. In that way, they had flexibility to do what they did based on what the generic safety issue was.

The next bullet down, the processing time may be shortened. I already mentioned that, that you could eliminate unnecessary analysis because of whatever the thresholds might be that you're not able to meet them.

They also thought there was a consensus on the scope of the generic issue early on. This was perceived by many as something that the old process possibly needed some fine tuning on and that was to, as Harold mentioned earlier, too, try and define what the scope of the issue is quickly so it's something

that everybody can get arms around that you can define, that you can see what the analysis should be, and then go ahead and work it as opposed to something that is foggy and too broad.

Next slide, please.

I did all the good stuff. Harold can do the rest.

MR. VANDERMOLEN: I get to do the shortcomings and limitations which also exist. The first one I think we've already discussed quite a bit. It's been administratively cumbersome. That's party because, as I said before, it's not hard to get people. It is very hard to get certain people. The people you really want for these things are often people who are very much in demand, very heavily committed.

What makes it even worse, particularly for reactor issues, you're dealing with two offices and all the implications that would imply. It's not easy. You have to get memos back and forth on a high level. It takes a while.

Also, the initial screening stage, which is the panel meeting, may not provide a sufficient basis for decision making. At this point you haven't done a quantitative or any semi-quantitative analysis, just

looking at the issue.

One of the outcomes the panel can vote on according to the management directive is to drop it based on it having very little -- I'm trying to quote it as exactly as I can -- very little chance of meeting the threshold criteria.

That's not so easy to do in practice. In fact, it's not always easy to make conclusions based on an actual quantitative PRA analysis. When you're trying to do it before you even do the analysis it gets a little bit more difficult still.

The threshold for processing candidate issues is not clearly defined for materials issues. What that means is there is an Appendix C attached to the handbook of the management directive that gives the criteria for reactor issues in terms of LERF and the usual PRA parameters. We don't have an analogous one for materials issues. We really need to develop something like that.

The documentation of "closed" issues for materials issues could be enhanced. The existing process is in an RES office letter. It only applies to RES but there is a very definite process we go to when we finally decide we're done with a generic issue how do we close it out. The answer is a resolution

package is written and, as I'm sure you all know, it comes down here for review.

After that, assuming all you gentlemen give us a positive letter, the letter is attached to the package, a cover letter goes on top. There is definite guidance on who concurs on it but it's signed by our office director and goes to the EDO. A similar thing had not been developed for NMSS and that's not really specified in the management directive.

Finally, we need a clear link between management directive 6.4 and GIMCS. GIMCS stands for generic issue management control system. It's our tracking system for all of the generic issues.

There is no requirement to use that specifically in the management directive. It just says that you want to have quarterly reports, although it's no problem when you're doing everything within research because research administers the system.

In fact, we are upgrading the system event. It used to run for many years under quarterly publications and we are trying right now to put it on the World Wide Web as well. It is public. Having gone through all that, we would like to keep GIMCS as our agency-wide tracking system and have everything on all generic issues in one place.

Moving on to the next slide, these are more observation. The last slide had shortcomings. These are observations. Not all of them are problems. The issues are complex. They do result in a significant amount of review time and some conflicts with other priorities.

The fact of the matter is nobody -- nobody puts a simple problem into the generic issue process. If you run across a simple question, you just go ahead and solve it. You don't go through all this. The ones we get are virtually guaranteed to be thorny.

I think if I did this over again I would strike that word often. If you have a generic issue, count on it. Actual practice says that it's not going to be simple or straightforward. It's going to take a little bit of effort to investigate and make these decisions.

DR. KRESS: What's the incentive or motivation for staff to serve on this panel? Because it's their civic duty?

MR. VANDERMOLEN: For reactor issues we provide them free donuts.

DR. KRESS: Okay.

MR. VANDERMOLEN: Other than that, they have to get all of their work done. Even with the free

donuts we didn't always get everybody quite as eager to serve as we want.

Issues can involve several disciplines. In just the issues we've talked about, we've had to consult people who had expertise in metallurgical sciences, expertise in reactivity, thermal hydraulics and thermal hydraulic phenomenon, post-accident phenomenon maintenance practices, the engineering of motor operated valves.

All of these things and you inevitably are going to wind up with a fairly large number of panel members. The higher the number of panel members, the harder it is to get everybody together.

I say that in the context of the next four bullets which manage to pull us in four orthaganol directions, hard to do in a Euclidian space. The key is that third bullet from the bottom.

It's difficult to establish a panel and complete initial screening stage within the required 30 days. Now, for one thing, it can take you at least a week and more likely two weeks just to get the metal out establishing the panel. Going through all of this in 30 days, it's just not realistic.

Backing up to the bullet right above it, greater commitment from NRC staff will be required to

establish panels. What we ran into here is that we discovered some of the offices were budgeting something like $100 for the year for these panels.

That would be fine if they gave us perfunctory things to do but you give us stuff where we're going to have briefing packages that are this big and then have a combined total of $100 for all issues. That's not realistic. I'm not complaining. The offices had to budget something and we didn't have the experience back then to find out.

When we finish this up we are going to check how many hours were spent on these panels and we'll be able to budget more appropriately.

Going on, there is still a desire by NRR for a more in depth risk based evaluation prior to drafting an issue from the generic issues program. When you get a generic issue somebody really believes in it. Now, some of these come from DPOs and we don't discourage this. This is how we handle a lot of them. Most of them actually come with the full backing of NRC management.

If the panel votes the thing into a drop, possibly that makes some people happy but someone thought enough of this issue to send it and it just doesn't work just to have a panel vote. You have to

have some basis. The panel has to document it as well and it's clear we have to have good guidance on how we do that documentation. It's just not going to wash just to say they voted.

Finally, as Ron mentioned earlier, if you have an issue that is voted to be a compliance issue, in theory that was supposed to say, okay, it's a compliance issue. It's not a generic issue. Give it back to NRR or NMSS. You've got the tools you need already to fix it. Just tell them to go do what they are supposed to do. Tell your licensees to do it.

Well, the people who have to enforce them want to be risk informed as well. What happened in reality with the heavy load issues, they came right back and said, "Tell us how important it is." That's an honest question and deserves an honest answer so we wind up doing the problemistic evaluation anyway.

Going on to the next slide, a few other observations. The previous generic issue process did not work so well either. I think it's pretty clear that we can't just go back to the old process. We do need some improvements. But we do feel that this whole process we've gone through comparing the two issues, although it had its frustrations, and I think Ron and I have more opportunity to be frustrated than

anyone, we do feel it was worthwhile.

I do want to add one more caution before we get into the recommendations and that is these lessons learned are not all inclusive. We haven't gotten anything all the way through the process. We probably have gotten most of the differences by going through the first three stages. At this point we haven't had any issue get past stage 3 of the management directive.

Stage 4 when you get into technical assessment, then you are going to contractors and spending big money. You are really working the issue and you'll have task action plans and all this sort of thing. That takes a lot longer but that's what needs to be done to fix these issues.

Going on, Ron.

MR. LLOYD: The next slide has to do with the recommendations based on our lessons learned from taking a look at both reactor and materials issues. The first thing kind of going through in chronological order as to really clarify the information that's in Appendix A.

Right now Appendix A is basically a table that list a whole bunch of items. It says to the person that wants to submit one of these things

whether it's outside the agency, with the industry, or inside the agency, "Here are a whole bunch of things that you need to put down which would include what you think the issue is, what you think the basis for the issue is, whether there's a regulatory problem. Also, what you think might be a solution to this problem."

When it gets to the panel, they would have a good idea of what the scope should be of that issue and that there should be some sort of direction for the panel to take from which to go out and do something.

I think Appendix A, or the documentation that would surround A, ought to be kind of flushed out a little bit. I think there would be much time, I think, spent in trying to figure out the scope. I think that needs to be clarified so everybody knows what the scope is. I think the appendix could be made more user friendly so better information could be put down. Another thing would be to actually enforce the fact that whoever wants to submit a generic issue and actually fill out Appendix A and provide that information rather than saying, "Yeah, I've got a bunch of information for you. Go do your thing," and then not follow the procedure in its entirety.

Another one was the initial screening stage. As Harold mentioned, it was difficult sometimes to limit the scope there. If you've got a bunch of engineers together, they want a lot of data upon which to make a decision.

Consequently, the initial screening state, which was really supposed to be kind of a basic look at the background, what was on Appendix A, and some basic kinds of information, really got into doing the kinds of things that were in subsequent stages within the management directive.

We had proposed here to limit some of the scope and make sure that people that were on that particular stage understood exactly what they were supposed to do.

Which gets us down to the third bullet. We felt that collapsing either stage three and four into one stage or stage two into three, and most likely stage two and three together would save some time and cut back on the amount of administrivia you would have to go through in order to process an issue.

Right now stage one is identification which is basically here's my background information as to why this might be a generic issue. The second stage is the initial screening which is basically to review

the preliminary information.

When you get to stage three, it's technical screening and that is supposed to be sort of a quick look based on expert opinion and analysis of what the situation is.

Then by the time you get to stage four, you are more of an in depth look. The in depth look would include things like going out to licensees, gathering data, doing PRA studies, getting a contractor, and other kinds of things to get more hard data upon which to make a decision.

We felt there were some similarities in here. Most likely the best thing to do would be to collapse stages two and three and make one that would best benefit the needs of everybody. It would save time and cut back on the administrivia that really isn't necessary.

Another issue that we had a problem as we did our very first one which was on the heavy loads area. We had our panel together and there were some questions as to what adequate protection really meant and what substantial --

CHAIRMAN APOSTOLAKIS: Did you answer it?

MR. LLOYD: You guys have answered that, right?

MR. VANDERMOLEN: I have every confidence in all of your deliberations.

MR. LLOYD: We went through and I took a look at all the documentation and everybody trying to figure out what adequate protection means. Of course, we are still trying to figure that out today. We did have a guest speaker come. Joe Murphy came and talked with us and he gave us his best interpretation of what all that meant. At least we had some input there.

As far as where the thresholds are, where your safety goal fits in, we tried to explain what that was. What we ended up doing was basically using the guidance that we have in Reg Guide 1.174 and that was just basically copied right into Appendix C of the management directive. We used the best guidance that we have to date.

If somebody here in the ACRS panel or in the agency is able to come up with a good definition of what adequate protection means with thresholds in there, we would gladly put that into the management directive and use some better information. Right now we're using the guidance that is provided by Reg Guide 1.174.

Next slide. For the materials issues, as Harold brought out, we really don't have any

thresholds that are out there that would give them a good idea as to whether this is an adequate protection issue or whether it's a safety enhancement issue or, to a lesser extent, a burden reduction issue.

We ran into the same problem when we were going through the inspection program trying to figure out under each one of the basic categories how much should we inspect, when should we inspect, what the frequency should be, what the impact on core damage frequency is.

If you're looking at an inspection issue from a reactor standpoint, how should you interpret that when you get over into the HP areas, the safeguards areas, the materials issues, the irradiators, those other kinds of things where you have different consequences of did things go bad. We really need to come up with something that NMSS and others could live with that would provide better guidance than what we've got right now.

The documentation, as Harold mentioned, we really need to add some additional information in there on actually how to close things out as we come to conclusions from the panels and other things that we know what we should do.

That means what is the proper format for

closing these things out. What's the proper distribution for closing these things out. What is the level of detail that is really needed. Can you do this in a three or four-page memo or do you need additional information that would attach some sort of small report in order to make it go on to the next step or to make the decision to drop that issue completely. Those things could be clarified.

The other one is on GIMCS. It's not mentioned in management directive 6.4 right now. At the time we wrote the draft we thought that we wouldn't be using GIMCS and so what's in the management directive is NUREG XXX.

What we've really decided to do, I believe, is to continue on with GIMCS but we are going to update it and it will be put on the Web so people will be able to get access to it. That change will have to be made.

Clarify the level of technical analysis that would be done within the scope of the MD. I think this should be more explicit at some of the early stages, once again to eliminate wasted time at addressing some of the issues that are of low risk significance and wouldn't meet any threshold.

The next slide we've got is a tentative

schedule for the next few months.

DR. KRESS: In your recommendations I didn't see anything to do with the problem of getting a panel together.

MR. LLOYD: Those kinds of things, as Harold mentioned, those would exist with the old system.

DR. KRESS: Those exist no matter why.

MR. LLOYD: Those exist no matter why.

DR. KRESS: No way to help that process? Do you have your own separate budget for generic issues?

MR. VANDERMOLEN: No, we do not. Generic issues process is no contract dollars whatsoever.

DR. KRESS: It's a stepchild.

MR. VANDERMOLEN: And a fairly small team, exactly half of which is sitting up here at the table at the moment. The other two, I see one in the audience. That's it.

MR. LLOYD: We're a small group. I think that was one of our issues from the administrative standpoint. We need to really raise this to a level of where people could be made available and that they would also realize what the approximate time commitment would be.

I think that ought to be put in the memo. I think offices should then be encouraged to stick

that in their budget. Assuming if we get the same amount of generic issues coming in, if we got four to six of these things in the period of a year, that equals X number of hours and then the different offices would just budget that amount.

DR. KRESS: Just getting that guidance to the offices might help.

MR. LLOYD: We should be able to provide guidance to the offices as to what to expect so it wouldn't be a surprise to them. Good point.

Slide 16 shows what we would like to do is to make some basic revisions based on lessons learned by the end of this month. That would then go through management review and research for a couple of weeks and then try to get it from the Office of Research by April 10.

We would also notify the EDO as to what we're doing in a memo that would basically forward our lessons learned. Then we would give everybody approximately a month to go through and do their peer review, get comments back to us by about mid-May, and then take the following six weeks to address those peer review comments, make the changes, and then get it once again out of Research by the end of June. It's an aggressive schedule.

DR. KRESS: It looks like May 11th time frame might be a good time for us to look at your changes and maybe make our comments then.

MR. LLOYD: Sure. You bet.

MR. LEITCH: I have a couple of questions.

MR. LLOYD: Sure.

MR. LEITCH: On the average how many of these issues are being identified per year?

MR. LLOYD: I think we are probably looking at right now maybe four to six.

MR. LEITCH: Four to six. And what is the average age of the open issues?

MR. LLOYD: It depends on what time period you're looking at. Some of these if you go back in time, we were looking at 15 to 20 years on some of these issues.

MR. LEITCH: I mean currently the ones that are open.

MR. LLOYD: Currently that ones that are open we've got --

MR. VANDERMOLEN: We've had some that go back 20 years. Having said that, I realize also that they go through a priority order based on these quantitative estimates, not on their chronological age. The ones that tend to be left are the ones that

were either very difficult to do or weren't of top safety significance. I'm not trying to apologize that they are that old.

MR. LEITCH: How many are open at the open?

MR. VANDERMOLEN: Ron Emerette, how many are open right at the moment? How many generic issues are open right now?

He'll tell you in a moment.

MR. EMERETTE: About 12.

MR. VANDERMOLEN: About 12 right now. We are also working these generic issues and we're getting for or six of them done.

DR. SHACK: Are you working them all with the new process or half?

MR. VANDERMOLEN: No, the older ones, the ones that are already in process, are still under the old process. What really makes them move is that we report to Congress every month on our progress and the end date of our task action plan goes to the Hill.

They don't pay too much attention to our intermediate milestones but if we don't make the final one, we don't like to think about that possibility because we try making deadlines.

MR. LEITCH: Are the goals of the new process to reduce the time or improve the quality?

What was the problem with the old process? Is it a quality issue or a timeliness issue?

MR. VANDERMOLEN: That's a little bit difficult for me to answer for two reasons. One is 20 years ago Tom Cox and I together wrote the old process so I guess I have a vested interest in it. The other reasons is that this management started based on about three years ago.

After the first draft had completed the office reorganized and I came in one day and discovered that I was once again in the generic issues process and the other people were not. The day ironically was April 1 of 1999 which I thought was a most appropriate date.

I can't completely answer the question. I think candidly people were having problems getting the probabilistic analysis done. I think part of it was they weren't following the old process that closely either. It wasn't that the old process was so bad but it was sufficiently difficult to use it and people were not following it.

MR. LEITCH: Is the prioritization step in the old process? I don't see a similar step in the old process.

MR. VANDERMOLEN: It's the technical

screening stuff.

MR. LEITCH: I see.

MR. VANDERMOLEN: At this step it comes in and we do a probabilistic analysis of it using what resources we have in house. That is, although we once had a contract on it, we don't go to licensees for information. We don't spend major dollars on it.

What we found is that at least 80 percent of the time based on the information we have in house we can say that this is a drop. If there's any doubt, that is, if we have unknown information, we put down a conservative figure.

This is how it differs from most PRA calculations that you'll see here. PRAs are supposed to be completely realistic. Then if there's doubt, we continue with it and then we go over to the next stage and spend money and do it right.

DR. BONACA: Just as an answer, if I remember, one of the major concerns was that because the first screening was not -- didn't have sufficient probabilistic analysis at the time, an issue was classified as potentially generic significance, would get there and then sit there for a long time and then years later would be evaluated and then dropped. You had a lot of potential GSIs. If I remember, that was

one of the issues.

MR. VANDERMOLEN: There was a significant backlog. It depends. When you get a reactor event happening, even one that is a precursor and wasn't really directly any kind of major threat, but we try and learn as much as we can. Every time that happens a flurry of generic issues comes. These do not come in on a regular basis. I'm almost afraid to say this, but they tend to be somewhat stochastic in their occurrence. You never know if you'll get none for a long time and then you've got three or four together all at once. That's one reason why the backlog develops.

I have to say also that doing the probabilistic analysis we read them after the fact and they look very straightforward but they look very differently when you start out with what I call NRC Form 0, a blank sheet of paper.

It's not always easy. Sometimes it takes a bit of thought, consultation, and work to actually do the issues and we can't do all of them. We can do most of them but we can't do all of them.

Other questions?

DR. WALLIS: You have a new process in draft form and you want to assess it but nothing so far has

got beyond step three, technical screening. The real work is done when you do technical assessment and develop regulations and guidance. No one has done that yet. It's a new process. How can you come up with a well-developed process when you haven't tested it yet in the main part?

MR. VANDERMOLEN: It is quite possible that we would have to go back and revise it again. The two aspects that I can say in partial reply, one is that when you get into the later stage of the issue, there's not that great a difference between the existing and the new process. They run much more in parallel. It's more that we track them further down rather than at a certain stage turn them over to another program.

The other is most issues don't make it that far. It's a fairly rare occurrence but a very significant occurrence when an issue makes it all the way through. In most cases, even when we go into complete technical assessment and really investigate the issue, it becomes a major research program and we may well find when we have all the information that this does not meet the criteria for any kind of regulatory action. It's pretty rare that things go all the way through. We have to allow for that

possibility, of course, and we have to do it with some vigilance.

MR. LLOYD: I would say that the old process went through those same set of phases as far as if you had rule making to do or some other kind of thing to do. You had corrective actions to come up with.

You had to figure out whether or not licensees actually implemented those corrective actions and verified that they were acceptable, that they would, in fact, solve the problem at hand. Those kinds of things were done under the old process. The difference was is there wasn't a procedure. They tried to track it.

I think all we really did in that whole formulation process was to go through NMSS, go through NRR, and get that process that was being used, give it our best shot at how to make it smooth, and go as smoothly as possible, and then we put it down on a piece of paper.

That's what you see under stages five, six, seven, and eight, the backend of the entire management directive. The frontend, as Harold mentioned, is really the part where you try to resolve the issue. After you've made a decision whether or not you're going to drop it, most of these would end up in the

drop category.

It was perceived, I think, by the agency and by Arthur Anderson, that helped us out on this, was that if you had a committee of experts looking at it initially, that you could come up with a pretty good fix on whether or not this would pass risk thresholds and, therefore, if we can get a real good fix on that, why should we go through and expend all of the resources to do that which we could do in a much shorter period of time.

If, in fact, we decide to move it on to another stage and to go out and do a real in depth analysis from a PRA standpoint, then we would go ahead and do that and there would be very little difference between what we would do under this procedure than what was done under the old procedure.

You might have one person doing it under the old procedure as opposed to a committee doing it under this procedure. We were looking basically for efficiencies and then also some staff reduction time because you've got to realize that we are cutting back staff.

DR. WALLIS: Do you have measures of those efficiencies and staff reduction times?

MR. LLOYD: We don't.

DR. WALLIS: Do you have measures of these efficiencies?

MR. LLOYD: As Harold mentioned, we are going to try to go back through and based on the timekeeping situation look at what was actually spent on these issues because we do have codes to charge against and we'll take a look at that.

CHAIRMAN APOSTOLAKIS: Okay. Any other comments? Thank you very much, gentlemen.

(Whereupon, at 3:46 p.m. the meeting was adjourned.)

<u>**CERTIFICATE**</u>

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

Docket Number: (not applicable)

Location: Rockville, Maryland

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.

John Mongoven
Official Reporter
Neal R. Gross & Co., Inc.

SUGGESTIONS FOR ENHANCING THE SPENT FUEL POOL RISK ASSESSMENT

Presented by:

Robert E. Henry
Lynette Hendricks

Presented to:
ACRS

March 1, 2001

ISSUES TO BE DISCUSSED

- Likelihood of SFP failure given a cask drop.
- Fission product releases if the SFP is postulated to be rapidly drained.
- Peer review of the report.

STATUS

- The draft study provides a good start for quantifying the risk of significant fission product releases from spent fuel pools.
- The study provides a good basis for evaluating the probability of losing cooling to the fuel pool.
- The study should incorporate the results of large scale spent fuel pool cask dropping experiments as well as those investigating large impact loads on reinforced concrete walls.
- The study currently represents the bounds of possible releases of ruthenium, we believe it should also provide a best estimate analysis consistent with relevant fission product release experiments.

-Assessing the Consequence of a Cask Drop – IMPORTANT EXPERIMENTS CHARACTERIZING CONCRETE TOUGHNESS

BNFL, 1984, "Full Scale Drop Test for Benchmarking Concrete Pads for Dry Spent Fuel Storage Casks: Tests 3 and 4," BNFL Commercial-In-Confidence Report AEA-D&W-0676 (work performed at AEA Technology, Winfrith).

BNFL, 1993, "Full Scale Drop Test for Benchmarking Concrete Pads for Dry Spent Fuel Storage Casks," BNFL Commercial-In-Confidence Report AEA-D&W-0622 (work performed at Sandia National Laboratories).

Witte, M. C. et al., 1998, "Summary of Evaluation of Low-Velocity Impact Test of Solid Steel Billet Onto Concrete Pads," NUREG/CR-6608, UCRL-ID-129211.

Stephenson, A. E., 1977, "Full-Scale Tornado-Missile Impact Test," EPRI Report NP-440 (work performed at Sandia Laboratories).

SIMPLIFIED APPROACH FOR ASSESSING DAMAGE (PENETRATION DEPTH) TO THE CONCRETE

M	-	mass of the cask.
h	-	drop height.
U	-	impact velocity.
ΔP	-	compressive strength of the concrete.
A	-	area of impact.
δ	-	depth of penetration.
KE	=	$1/2\ MU^2 = \Delta P\ A\ \delta$
δ	=	$\dfrac{MU^2}{2\,\Delta P\,A} = \dfrac{M\,g\,h}{\Delta P\,A}$

RESULTS OF BNFL (AEA/SNL) CASK IMPACT TESTS

Test Conditions	
Mass of the test cask	64.5 tonnes
Average concrete compressive strength	22 MPa
Test #2	
Drop height	18 in. (0.46 m)
Calculated free fall velocity at impact	3 m/sec
Kinetic energy of cask at impact	2.9×10^5 J
Calculated compression of the concrete	8 mm
Measured compression (depression of surface)	4 mm
Test #3	
Drop height	40 in (1.02 m)
Calculated free fall velocity at impact	4.5 m/sec
Kinetic energy of cask at impact	6.5×10^5 J
Calculated compression of the concrete	17 mm
Measured compression (depression of surface)	6 mm
Test #4	
Drop height	60 in (1.52 m)
Calculated free fall velocity at impact	5.5 m/sec
Kinetic energy of cask at impact	9.8×10^5 J
Calculated compression of the concrete	26 mm
Measured compression (depression of surface)	8 mm

RESULTS OF EPRI MISSILE TESTS

Test #10 – 12" thick reinforced concrete

Missile: 12" pipe – 743 lbm (338 kg)
Velocity: 143 ft/sec (43.6 m/sec)
KE = 3.2×10^5 J
ΔP = 3690 psi (25.4 MPa)
F = $A\Delta P$ = 1.8×10^6 N
δ = 0.2 m; $\delta_{measured}$ = complete penetration

Test #12 – 18" thick reinforced concrete

Missile: 12" pipe – 743 lbm (338 kg)
Velocity: 203 ft/sec (61.9 m/sec)
KE = 6.5×10^5 J
ΔP = 4535 psi (31.3 MPa)
F = $A\Delta P$ = 2.2×10^6 N
δ = 0.29; $\delta_{measured}$ = 7.5 in. (0.19 m)
(observed some spalling off the back face)

Test #9 – 18" (0.45 m) thick reinforced concrete

Missile: 12" pipe – 743 lbm (338 kg)
Velocity: 143 ft/sec (43.6 m/sec)
KE = 3.2×10^5 J
ΔP = 3545 psi (24.4 MPa)
F = $A\Delta P$ = 178E6N
δ = 0.18 m; $\delta_{measured}$ = 5 in. (0.127 m)
(no spalling off the back face)

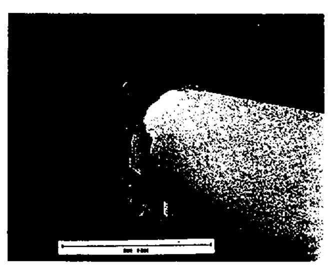


Figure 8-27. Frontface Damage, 12" Pipe, 143 fps, 12" Panel

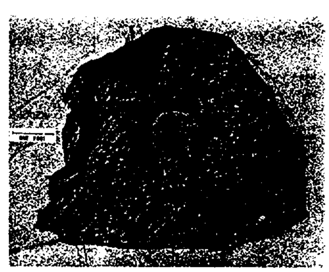


Figure B-28. Backface Damage, 12" Pipe, 143 fps, 12" Panel (Concrete appearing through hole is another test panel)

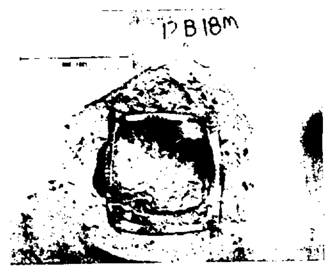


Figure B-31. Frontface Damage, 12" Pipe, 203 fps, 18" Panel

Figure B-32. Backface Damage, 12" Pipe, 203 fps, 18" Panel

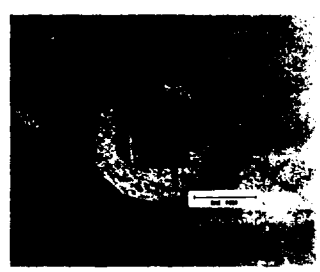


Figure B-23. Frontface Damage, 12" Pipe, 143 fps, 18" Panel

Figure B-24. Backface Damage, 12" Pipe, 143 fps, 18" Panel

SUMMARY OF THE EPRI 12" PIPE (743 lbm/388 kg) MISSILE IMPACT TESTS

Test	Impact Velocity (ft/sec)(m/sec)	Concrete Strength (psi/MPa)	Concrete Thickness (in/cm)	Measured Penetration (in/cm)	Calculated Penetration cm	Ratio of Calculated to Total Thickness	Observation (Spalling)
14	92/28.1	3545/24.4	12/30.5	3.9/9.9	7.5	0.25	Slight
16	92/28.1	3350/23.1	12/30.5	3.5/8.9	7.5	0.25	Slight
11	98/30	3595/24.8	12/30.5	4.5/11.4	8.4	0.28	Some
9	143/43.6	4325/29.8	18/46	5/12.7	14.7	0.32	None
10	143/43.6	3690/25.4	12/30.5	Perforation	18	0.59	Perforation
15	152/46.4	4205/29	18/46	5.3/13.5	17	0.37	Slight
17	157/47.9	4255/29.3	18/46	4.1/10.4	18	0.39	Slight
4	198/60.4	3560/24.6	18/46	6.8/17.3	34	0.74	Extensive
3	202/61.1	3350/23.1	18/46	7.0/17.8	38	0.82	Extensive
12	202/61.6	3795/26.2	24/71	6.8/17.3	29	0.41	Some
18	213/65	4690/32.2	18/46	9.1/23.1	30	0.65	Hole Opened

SUMMARY OF RESULTS FROM CONCRETE IMPACT TESTS

- The large scale cask drop experiments demonstrate minimal damage associated with the cask drop events from 18 inches, 40 inches and 60 inches.
- The observations from high velocity missile impact experiments demonstrate results that are consistent with those observed in the cask drop test, i.e the depth of penetration is approximately ½ or less of the calculated value.
- Only relatively small cracks appear before "spalling" is observed in the back side of the concrete wall.
- The high velocity impact tests show that "spalling" on the back side of the concrete wall occurs when the calculated penetration depth is approximately half of the wall thickness.
- Without "spalling", there would be no large leakage path to rapidly drain the spent fuel pool.

APPLICATION OF THE CONCRETE IMPACT EXPERIMENTS TO A SPENT FUEL POOL

- The height used here to evaluate for drops in a spent fuel pool is 9 meters.
- Evaluation of a cask drop should include the buoyancy and drag of the water.
- The impact velocity from a 9 m drop is approximately 12 m/sec, i.e. twice that in the BNFL/AEA 60 in. drop test.
- Hence the damage would be about 4 times that observed in the BNFL/AEA test, i.e. a depression of 4 x 8 mm = 32 mm (calculated value = 12.5 cm).
- This is much less than half of the pool floor thickness (pool floor thickness ~ 1.5 to 2 m).

Conclusion:

This would not be sufficient to cause "spalling" of the back face of the pool floor (liner strength has not been included). Hence, a cask drop event is much less than that required to cause a failure sufficient to rapidly drain the spent fuel pool.

IMPORTANT EXPERIMENTS CHARACTERIZING Ru FISSION PRODUCT RELEASES

- Oak Ridge Test VI-7 – BWR irradiated fuel segment (6 in.) with Zr cladding – No significant ruthenium release until essentially complete oxidation of the Zircaloy cladding.
- CANDU experiments H02 and H05 – irradiated fuel segment (1 in.) with Zr cladding – No significant ruthenium release until complete oxidation of the cladding.

ANALYTICAL CONSIDERATIONS

- The fuel assembly geometry and the special considerations for a spent fuel pool (boraflex, boral, etc.) influence the natural circulation flowpaths through the pool.
- If a partially drained fuel pool prevents natural circulation through the core, steam is the only significant oxygen source for cladding oxidation. Boildown calculations for this configuration shows that the cladding oxidation would be limited to 10 to 15%, i.e. there would be a large fraction of unreacted cladding.
- BWRs would have more zircaloy than PWRs.
- For those upper regions of the fuel, cladding could melt and drain away from the fuel. However this is limited by:
  - the tight pitch of the fuel pins,
  - melt relocation between the pellet and the cladding,
  - dissolution of the UO_2 by the molten clad, and
  - freezing of the molten material as it drains..

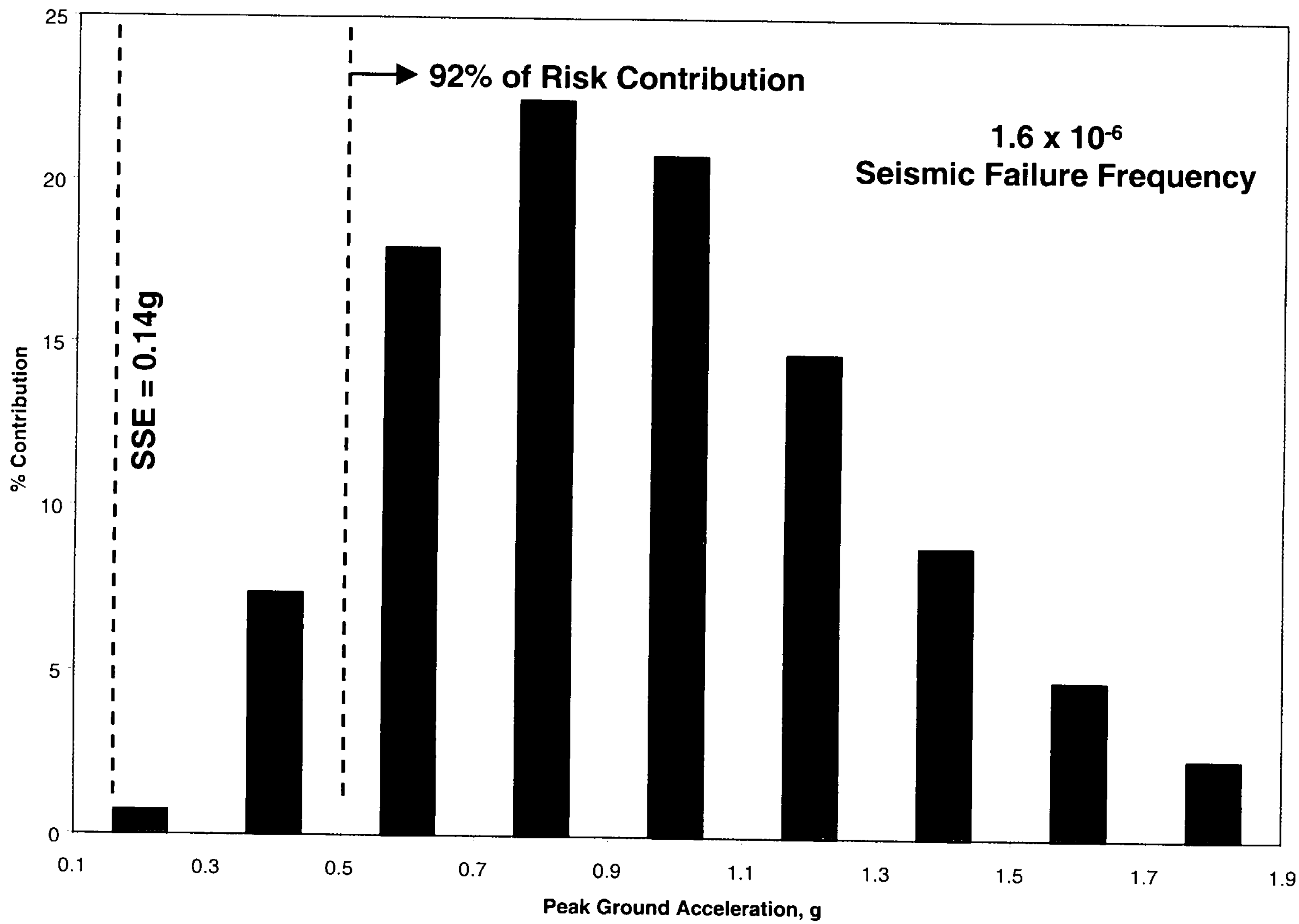
RECOMMENDED EXPANSION OF THE TECHNICAL BASIS

- Provide estimates of the oxidation extent before the fuel slumps
  - CODEX,
  - TMI-2,
  - MELCOR calculations.
- Use the available experiments basis to estimate the Ru releases based on ZrO oxidation and debris temperature
  - ORNL tests (unclad pellets),
  - Chalk River experiments
    - unclad fuel,
    - with fuel cladding.
- Need to consider that some fuel from the top of the pins could be declad (exposed). However, this would also form a particle bed on the upper surface and would be at a lower temperature due to thermal radiation.

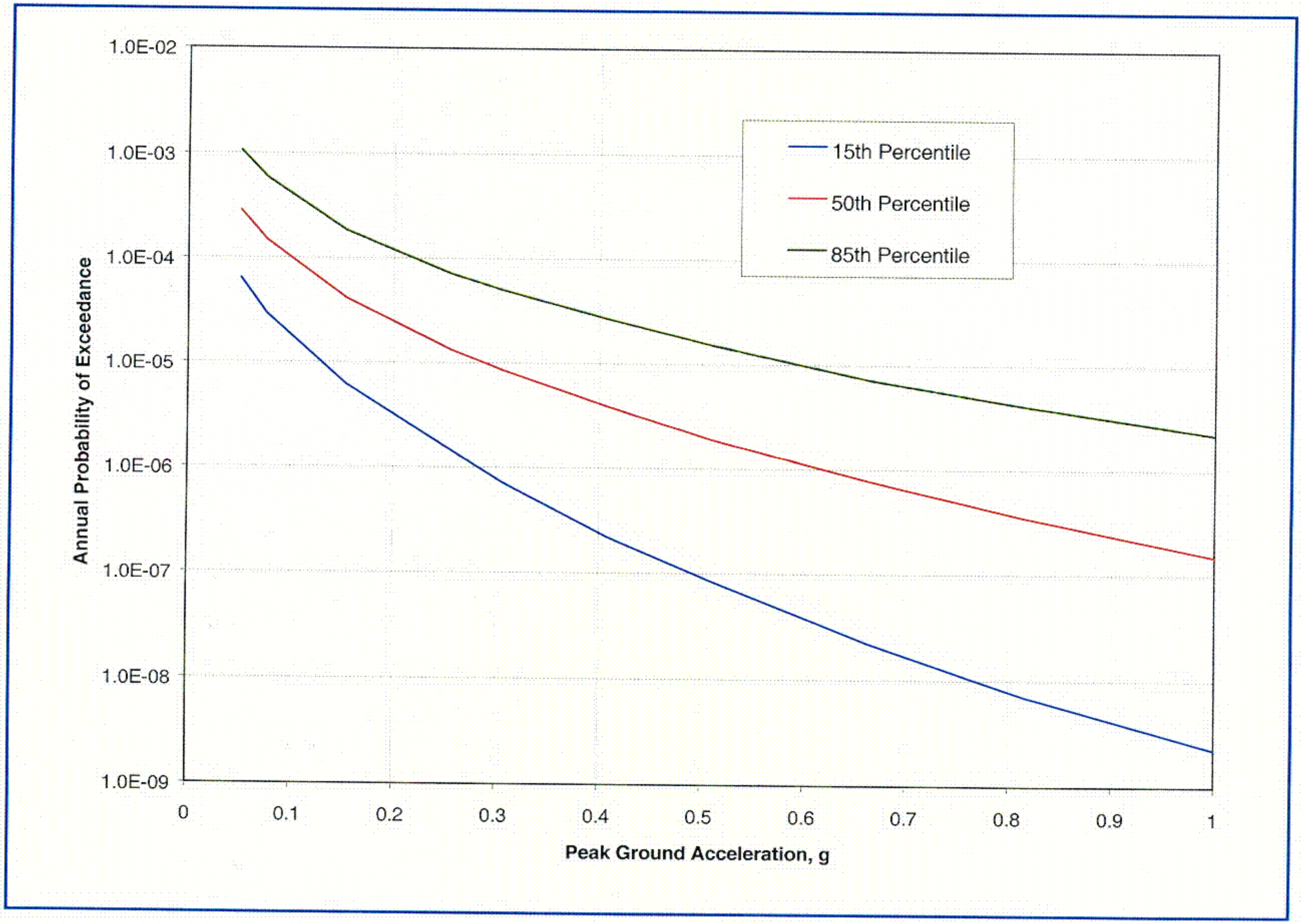
CONCLUSIONS

1. Evaluations for the cask drop events need to incorporate the results of the experiments that have been performed for cask drops as well as other impact loadings on reinforced concrete. A quantitative failure condition should be used to assess the likelihood of such events causing rapid drainage of the spent fuel pool.
2. The risk evaluation should include a representation of a best estimate Ru source term based on the results from radiated fuel with Zircaloy cladding.
3. A peer review is recommended. This is an efficient manner to assure that the relevant experience and experimental insights have been incorporated.

Acceleration Range Contribution to Spent Fuel Pool Structural Failure Probability – Vermont Yankee



Surry Uniform Hazard (PGA)



C-1

Industry Observations and Recommendations on Seismic Risk

- Both Deterministic and Probabilistic Seismic Hazard should be considered with respect to any seismic decommissioning regulations
  - Maximum Credible Earthquake Concept should be utilized in this evaluation
  - Tails of random uncertainty term should be truncated at high ground motions
- Earthquake levels which drive the seismic risk should be evaluated for reasonableness
  - Seismic risk comes from extremely large (and correspondingly low probability) earthquakes
  - Increasing the Seismic Capacity (to meet NRC proposed criteria) would translate to redesigning the SFP to an earthquake level several times the SSE

South Texas Project Exemption Request

ACRS Subcommittee Report

Dr. George Apostolakis
John Sieber

March 1, 2001

STP Exemption request

- Plant Description, two units, 4 loop W PWR's rated at 1250 MW each.
- Owned by HPL Co, Houston, TX
- Commercial Operation, 1988.
- Three safety trains.
- Lake cooled.
- Large, dry containments.

STP Exemption Request Purpose

- Identify components that are important to safety, from a risk standpoint, and eliminate components not important to safety from the requirements of 10CFR, App B and Special Treatment Requirements.
- Identify non-Q components that are important to safety.

STP Components

(for a 2 Unit Plant)

Total number of components in 29 safety systems.	43,690
Total number of components classified as "Q" components	16,715
Total number of components identified in a typical PRA analysis (2 Units).	2,400

STP Categorization Process
Two Methods were used.

- Re-categorization based on the use of plant specific PRA's. 5.7 percent.

- Re-categorization based on "Expert Panel" elicitation. – 94.3 percent.

STP Categorization Process

Total number of components in 29 systems.	43,690
Total number of components described in typical PRA's (for two units.)	2,400 5.7%
Number of components whose risk contribution must be evaluated by the Expert Panel.	41,290 94.3%

STP Categorization Methodology based on PRA results (5.7%)

PRA Ranking	Criteria
High	RAW ≥ 100.0 or FV ≥ 0.001 or FV ≥ 0.005 and RAW ≥ 2.0
Medium - R	FV < 0.005 and RAW between 10 and 100.
Medium	FV ≥ 0.005 and RAW < 2.0 or FV < 0.005 and RAW between 2.0 and 10.0
Low	FV < 0.005 and RAW < 2.0

STP Categorization Process

Expert Panel (94.3 %)

- Expert Panel uses Five (5) critical questions.

- Expert Panel ranks each component by the component's sensitivity to frequency of occurrence (demand) and/or perceived risk impact.

STP Categorization Process

Expert Panel Questions

- Does the loss of this function cause an Initiating event?
- Does the loss of this function directly fail another risk significant system?
- Is the function used to mitigate accidents or transients?
- Is this function directly called out in EOP's and ERP's?
- Does this function directly affect safe shutdown or mode changes?

STP Categorization Process

Expert panel – Weighting Factors.

- For each Function, the Five Questions are asked and a weighting factor is applied to each question.

- Also, for each Function, an additional weighting factor is applied to reflect the presumed frequency of occurrence.

STP Categorization Process

Final Weighting of Expert Panel Results.

- A weighting scale is used to account for the impact or frequency of occurrence of the failure of the function.
- The combination of these factors is used to arrive at a final score, which ultimately determines the risk significance of that component that serves that function.

STP Categorization Process

Final Weighting of Deterministic Scores

Score Range	Risk
0 - 20	Not Risk Significant
21 – 40	Low Risk Significance
41 - 70	Medium Risk Significance
71 – 100	High Risk Significance

STP Exemption Request ACRS Questions

- When PRA's use CDF and LERF as the criteria, do we get the correct outcomes?
- Are RAW and FV the correct measures of importance of a component, in this context?
- Do the deterministic questions and the weighting factors make sense?

STP Categorization Process Results

Safety Related, Risk Significant components 3,810 (8.7%)	Non-Safety Related, Risk Significant 372 (0.9%)
Safety Related, Non-risk Significant 12,905 (29.5%)	Non-Safety Related, Non-Risk Significant. 26,603 (60.9%)

STP Exemption Request
Open Items

Open Items	12
Confirmatory Items	1
Items awaiting RILP approval	4
Remaining Open Items	7

United States
Nuclear Regulatory Commission

Trial Use of Management Directive 6.4, *Generic Issue Program*

Harold VanderMolen
Ronald Lloyd

Division of Systems Analysis
and Regulatory Effectiveness
Office of Nuclear Regulatory Research

480th ACRS Meeting
March 1, 2001

Status of Reevaluation of the Generic Issue Process

April 9, 1999:	Incomplete Draft MD 6.4 Issued for Peer Review
April 19, 1999:	ACRS Recommends the Staff Conduct a Pilot Study to Evaluate the Effectiveness of Using a Draft MD for Implementing the Revised Generic Issue Process Prior to Developing a Final Version of MD 6.4 and its Associated Handbook
July 21, 1999:	Issued a Complete Version of the Draft MD
October 21, 1999:	Revision 1 to the Draft MD Issued to Address OGC Comment Clarifying Its Nature and Purpose
March 1, 2001:	(1) Provide an Update to the ACRS Concerning Lessons Learned During the Trial Use of MD 6.4 in Addressing Candidate Reactor and Materials Generic Issues, and (2) Request Approval to Revise the Draft MD and Issue a Final MD

Comparison of Draft MD and RES Office Letter Generic Issue Processes

Draft Management Directive 6.4	RES Office Letter No. 7
1. Identification 2. Initial Screening 3. Technical Screening 4. Technical Assessment 5. Regulation and Guidance Development 6. Regulation and Guidance Issuance 7. Implementation, and 8. Verification	1. Identification 2. Prioritization 3. Resolution

Generic Issue Processing Using Draft MD 6.4

Type	Title	Lead Office	Date Initiated	Current Status
Reactor	*Potential Risk and Consequences of Heavy Load Drops in Nuclear Power Plants* (GI-186)	RES	5/1999	Technical Screening Ongoing
Reactor	*Potential Impact of Postulated Cesium Concentration on Equipment Qualification in the Containment Sump* (GI-187)	RES	12/1999	Initial Screening Ongoing
Reactor	*Steam Generator Tube Leaks/Ruptures Concurrent With Containment Bypass* (GI-188)	RES	6/2000	Initial Screening Ongoing
Materials	*Leaking Pools* (i.e., BWX Technologies, wet storage irradiators, ISFSIs, others containing radioactive materials)	NMSS	10/2000	Dropped (1/26/2001)
Materials	*Unlikely Events* (inappropriate use of "unlikely events" in support of the double contingency principle of ANSI/ANS- 8.1-1983, "Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors")	NMSS	10/2000	Dropped (1/26/2001)
Materials	*Gamma Stereotactic Radiosurgery* (Misadministrations, NMSS-0020)	NMSS	10/2000	Dropped (2/12/2001)

Control Candidate Generic Safety Issue

- **For Comparison with MD 6.4, GI-185 *Control of Recriticality Following Small-break LOCAs in PWRs* Was Screened Using the "Old" Generic Safety Issue Process (RES Office Letter No. 7: *Procedures for Identification, Prioritization, Resolution, and Tracking of Generic Issues*)**

MD 6.4 Trial Period Experience:

Candidate Reactor Generic Safety Issues:

- GI-186 *Potential Risk and Consequences of Heavy Load Drops in Nuclear Power Plants* (Now in Technical Screening Stage)
  - Panel Met Successfully and Determined That the Issue Would Be Classified as a "Compliance Issue" and Dropped
  - NRR Requested That the Risk Significance of the Issue Be Reviewed More In-depth
  - NRR Became Concerned about the Number of Staff Hours Being Consumed to Support Panel Meetings
  - RES Visited Eight Facilities to Obtain Operating Experience Data and Load Drop Studies

- GI-187 *Potential Impact of Postulated Cesium Concentration on Equipment Qualification in the Containment Sump* (Now in Initial Screening Stage)
  - Difficulty Encountered in Arranging Panel Meetings
  - Panel Agreed on the Conclusion to Drop the Issue, but Disagreed on Specifics of Justifying the Conclusion

MD 6.4 Trial Period Experience (Continued):

Candidate Reactor Generic Safety Issues (Continued):

- GI-188 *Resonance Vibrations of Steam Generator Tubes Following MSLB Event* (Now in Initial Screening Stage)
  - Technically, a Very Complex Issue Involving a Spectrum of Disciplines
  - Difficult to Get an Expert Panel Together
  - Delays Occurred Due to Unavailability of the Staff Member Who Raised the Issue
  - Significant Amount of Briefing Material

MD 6.4 Trial Period Experience (Continued):

Control Issue Processed under the "Old" System:

- GI-185 *Control of Recriticality following Small-Break LOCAs in PWRs*
  - A Complex Technical Issue Requiring an In-depth Review
  - Prioritization Completed in Six Weeks, but Concurrence Review Lasted 197 Days

MD 6.4 Trial Period Experience (Continued):

Candidate Materials Generic Safety Issues:

- No Candidate-specific Generic Safety Issue Comments
- All Three Candidate Issues Were Dropped Following Panel Review
- General MD 6.4 Comments Have Been Included in the Summary Observation Slide

Summary Observations During Trial Use of Draft MD 6.4

Positive Draft Process Observations:

- **Opportunity to Save Staff Resources for Those Issues That Are Clearly of Low Risk Significance and Are Dropped from the Generic Issue Program**
- **Opportunity to Save Staff Resources for Compliance Issues**
- **Formality of the Process Gives it Visibility at All Levels**
- **Flexibility in Use of Handbook Guidance Especially Useful**
- **Generic Issue Processing Time May Be Shortened by Eliminating Unnecessary Analysis**
- **Consensus on Scope of the Candidate Generic Issue Achieved Early in the Process**

Summary Observations During Trial Use of Draft MD 6.4 (Continued)

Shortcomings and Limitations in Process:

- In Some Instances, the Panel Concept Has Been Administratively Cumbersome
- Initial Screening Stage May Not Provide Sufficient Technical Basis for Decisionmaking
- Threshold for Processing Candidate Issues Not Clearly Defined for Materials Issues
- Documentation of "Closed" Issues for Materials Issues Could Be Enhanced
- A Clear Link Between MD 6.4 and GIMCS Needs to Be Established

Summary Observations During Trial Use of Draft MD 6.4 (Continued)

Administrative Draft Process Observations:

- Issues Are Often Complex, Resulting in a Significant Amount of Review Time, and Conflicts with Other Priorities
- Issues Can Involve Several Disciplines Resulting in a Large Number of Panel Members
- Greater Commitment from NRC Staff Will Be Required to Establish Panels, Set Aside Time to Review and Process Candidate Generic Issues in a Timely Manner
- Difficult to Establish a Panel and Complete the Initial Screening Stage Within the Required 30 Days
- There Is Still a Desire by NRR for a More In-depth Risk-based Evaluation Prior to Dropping an Issue from the Generic Issue Program
- Similarly, Those Who must Enforce "Compliance" Issues Have Expressed a Desire for a Risk Assessment

Other Observations:

- The Previous Generic Issue Process Did Not Work Well During this Trial Period in Addressing GI-185

Caution:

- Lessons Learned Are Not All Inclusive; in That MD 6.4 Guidance Currently Includes 8 Stages, No Candidate Generic Issue Has Been Processed Beyond Stage 3 of the MD

Recommendations

- **Add Clarifying Information to Appendix A (Candidate Generic Issue Submittal Form) to Better Focus the Generic Issue Review Panel**
- **Clarify the Requirements of the "Initial Screening Stage" to Limit the Scope of the Panel**
- **Combine the Technical Screening and Technical Assessment Stages to Provide a Better Technical Basis for Decisionmaking; OR Combine the Initial Screening and Technical Screening Stages to simplify the process**
- **Provide Clearer Guidance on the Distinction Between "Adequate Protection" and "Substantial Safety Enhancement"**
- **Delay the Generic Issue Classification into "Adequate Protection," "Substantial Safety Enhancement," or "Burden Reduction" to the Technical Screening/Assessment Stage when additional technical analysis results are available**

Recommendations (Continued)

- Threshold Requirements for Processing Candidate Issues Should be Clarified for Materials Issues
- Documentation Requirements for "Closed" Issues Should be Enhanced
- A Clear Link Between MD 6.4 and GIMCS Should be established
- Consider Greater Sharing of Other Forms of "Generic Communication Issues" Between Offices
- Clarify the Level of Technical Analysis That Would Be Done Within the Scope of the MD

Tentative Schedule for Issuance of MD 6.4

- **Make Revisions to MD 6.4 Based on Lessons Learned:** March 30, 2001
- **Distribute MD 6.4 for Peer Review Within the Agency:** April 10, 2001
- **Notify the EDO Concerning Pilot Study for Generic Issue Program:** April 10, 2001
- **Obtain Final Peer Review Comments on MD 6.4:** May 11, 2001
- **Issue Final Version of MD 6.4 for Publication:** June 29, 2001