UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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COMMISSION MEETING WITH THE ADVISORY COMMITTEE

ON REACTOR SAFEGUARDS (ACRS)

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ROCKVILLE, MARYLAND

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WEDNESDAY, JULY 10, 2002

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The Commission met in open session, at 2:00 p.m., at the Nuclear Regulatory Commission, One White Flint North, Rockville, Maryland, the Honorable Richard A. Meserve, Chairman of the Commission, presiding.

COMMISSIONERS PRESENT:

RICHARD A. MESERVE, Chairman of the Commission

GRETA J. DICUS, Member of the Commission

EDWARD McGAFFIGAN, JR., Member of the Commission

JEFFREY S. MERRIFIELD, Member of the Commission

STAFF AND PRESENTERS:

GEORGE E. APOSTOLAKIS, Chairman of the ACRS

MARIO V. BONACA, Vice Chairman of the ACRS

THOMAS S. KRESS, Member of the ACRS

DANA A. POWERS, Member of the ACRS

WILLIAM J. SHACK, Member of the ACRS

(This transcript produced from electronic caption media and audio and video media provided by the Nuclear Regulatory Commission.)

C-O-N-T-E-N-T-S

RISK-INFORMED SPECIAL TREATMENT REQUIREMENTS:

Dr. George E. Apostolakis 12

PRESSURIZED THERMAL SHOCK:

Mr. F. Peter Ford

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

(2:05 P.M.)

CHAIRMAN MESERVE: Good afternoon. On behalf of the Commission, I'd like to welcome the Advisory Committee on Reactor Safeguards to the meeting this afternoon, and to those of you in the audience who are here to participate. The Commission meets with the ACRS twice a year to discuss issues of current interest. I think we last met in December.

We look forward today to discussing license renewal and power uprates, advanced reactors, the NRC's efforts to risk-inform the special treatment requirements, and then finally the Office of Research's program to re-evaluate the technical basis for the NRC's rule governing pressurized thermal shock.

I'm pleased to welcome all of you to join with us this afternoon. ACRS plays a vital role in providing the Commission candid, independent technical assessments of our activities, and we always look forward to discussing the things you bring to us with you, so thank you very much.

Dr. Apostolakis, you may proceed.

DR. APOSTOLAKIS: Thank you, Mr. Chairman. Good afternoon, Commissioners. We have three detailed presentations today on Advanced Reactors, Risk-Informing Special Treatment Requirements and the Pressurized Thermal Shock Evaluation Project, but before we go to those, I will give a brief overview of various activities that the Committee has undertaken regarding Core Power Uprates, License Renewal Activities, and I'll briefly talk about future Committee activities.

Regarding Power Uprates, we have -- we are only reviewing requests for Uprates that exceed 5 percent of the power rating. We have reviewed and approved five requests, those shown on the slide. The lead members are Dr. Wallis, Powers and Sieber on the Committee.

We also reviewed the General Electric Topical report on Constant Pressure Power Uprate, which is the basis for how the boiling water reactor operates. The Staff approved it, and we approved it.

We expect to review four or five applications in the year 2003, and then another certain number in the year 2004. And some of the issues that the Committee has raised, we complained about the adequacy of documentation in the Staff Safety Evaluation reports. We are pleased to report that the Staff has heard us and the documents that we've been receiving have been improving steadily.

We also expressed the need for a Staff Guidance Document on future operate reviews, and following an SRM from the Commission, the Staff is developing a review standard which we will be briefed on this week, in fact.

The Office of Reactor Regulation is performing audits to confirm appropriate use of approved methodology regarding the Core Reload Safety Analysis, and the ACRS has no objection to that practice.

We also identified the need for a Staff audit of the calculations and detailed thermal hydraulic models, and the Staff is considering to put these into the review standard that is being developed.

We have also said that if the review identifies issues that would be relevant to the work of inspector, perhaps high flow assisted corrosion rates, then the inspector should be informed of these findings. And regarding license renewal, this effort is being lead by Dr. Bonaca, and we formed a second sub-committee under the chairmanship of Mr. Leech. In fact, they had their first meeting yesterday.

We have completed our review of Turkey Point, and also we have completed our reviews of at least one plant on each vendor, and we have decided not to issue interim letters routinely, but only as needed from now on.

We are now reviewing the North Anna and Surry applications, and in the fall we expect to receive McGuire, and Catawba, and Peach Bottom and St. Lucy applications. As I said earlier, we do have two license renewal sub-committees to handle the load.

And regarding future Committee activities we will, of course, keep reviewing documents from the Staff that deal with risk-informed performance-based regulations. We plan to continue our work on reactor operations, especially the reactor oversight process. We have made several comments, as you know, in the past regarding the quality and effectiveness of the process.

Mr. Sieber and I met with the Staff and discussed several of these comments, and we are beginning to approach agreement. We will issue a safety research -- a report on safety research, with the focus on advanced reactors. And we are also, of course, interested in High-Burnup Fuels and MOX facility.

We have a sub-committee on Safeguards and Security. We had a meeting with the Staff for about three hours last May, and we are now in the process of scheduling another meeting for at least a day this September. Fire protection is always something we're interested in, reviewing transient and accident codes. Human factors, there is a new plan from the Office of Research that we plan to review in September.

Safety culture or Safety Conscious Work Environment, there are all sorts of issues there. We know the sensitivities involved as to how much the Regulatory Agency can do in this area. On the other hand, we had a major incident recently that perhaps points to the need of somebody doing something about safety culture, so the Committee is planning to think about it, taking into account all these concerns.

In Naval Reactors, we have met with Naval Reactor people twice, and we have another sub-committee meeting scheduled for August, and we plan to issue a letter in September. Now we can start the -- I assume we will handle it like last time. The first briefing is on Advanced Reactors, by Dr. Kress.

DR. KRESS: Thank you, George. We do have a Futures Reactor Sub-committee, which we formed just so we could organize our activities in this area. And the reason I'm giving the talk, at least one reason is I'm the Sub-committee Chairman for the Future Reactor Sub-committee.

The report today is mostly just a status report on what our activities have been. We have been quite active. We're trying to stay engaged with the Staff so we can keep on top of what their issues are, and then get our input. You know what most of these activities have been, workshop on high temperature gas-cooled reactor safety. It was the main topic there on retreat. We sponsored our own workshop which is somewhat unusual for ACRS, and I participated in the briefing of the Commission on the gas-cooled reactors.

In order to be sure we accommodate the Staff's needs for our review, we're working with them to develop an action plan for the ACRS participation. We've just about finished that, and they will help us keep things in order, keep organized, and keep engaged with the Staff.

We recently, last June, heard the discussion on the policy issues raised -- policy and technical issues raised by the Staff Research, and wrote a letter in June on that subject. And basically, the letter doesn't say very much. We agreed with the Staff on what they identified as two over-arching policy issues, one of which was what do they do about implementing what's -- the "expectation", and that's in quotes, "that advanced reactors will have enhanced margins of safety". Just

what does that mean?

We suggesting that another over-arching policy issue that might be separated out included with these two would be defense and depth, and how to deal with it, particularly with respect to the gas-cooled reactor concepts. And the other over-arching issue was how does the NRC safety requirements compare and fit in with the international safety requirements? We really didn't think that was an over-arching issue, but we thought it was worthwhile pursuing.

We suggested that it would not be unreasonable for different countries to have different safety standards, that there's no real reason that they should be completely the same, because different countries have different situations, different values, different needs, so it's not unreasonable to think they would have different safety standards.

At that meeting, also the Staff identified technical issues that they thought were key, and we agreed that these were key technical issues. We didn't -- our letter is pretty silent on how to deal with these because we hadn't -- have not yet debated these issues, and arrived at positions. That's one of the things we're doing internally in the Committee, is trying to develop strawman positions on various technical issues so that we can be prepared to give you our best advice on those. We haven't reached that stage yet on these, but we have been trying to decide among ourselves what would be the major impediments in the regulatory arena for Advanced Reactors.

In our briefing for the Commissioners on gas-cooled reactors, I pointed out what I thought were three major ones, and we'll present it on this slide. We are engaged in continuous conversations with the Staff on our feelings about how to deal with these, and are beginning to arrive at positions that are somewhat in line with those of the Staff. I think we're pretty far apart on these issues right now. We'll keep talking to them.

Currently, our priority is with AP1000, we think that's the one we have to deal with first. We don't see any show-stoppers there. We think AP1000 is at least certifiable, and that the Staff has their finger on all the issues associated with it, so we don't really see any problem there, except getting the reviews done, and taking care of it.

We are trying to develop an interim action plan, schedule things like that Camden reactor, which I think they've expressed interest in pre-certification, as well as the ESBWR. We did not have those in our original action plan because we didn't realize they were coming on, but we're now working those in.

We're trying to develop strawman positions on what we think are the potential impediments, and we're getting pretty far along the line with those, so we can provide you with our advice.

That's it, George.

DR. APOSTOLAKIS: Thank you, Tom.

MALE SPEAKER: Mr. Chairman, just a little bit out of order, but he said there are large differences between them and the Staff on these possible impediments, and I'm just interested in knowing what those differences are.

DR. KRESS: They agree that these are impediments. We don't differ in that. We disagree on potential approaches to getting over these impediments. I think the Staff is thinking in structuralist lines, while we're thinking in rationalist lines, and those are --

MALE SPEAKER: God help us.

DR. KRESS: Yeah, that's right. I shouldn't say that as a blanket statement for our Committee, because our Committee is split on those issues. This should reflect only my own position on that.

DR. APOSTOLAKIS: The first bullet I think is relevant to my talk too, regarding the lack of high level risk acceptance criteria other than core damage. This is a continuing theme, and I'll come to it also later, because that's also a difference.

CHAIRMAN MESERVE: I think we've heard from you on that subject at the briefing, George. That's all right.

DR. APOSTOLAKIS: Okay. Risk-informing the special treatment requirements of 10 CFR Part 50. The first slide shows the heart of the matter here, which is the classification, categorization of the system structures and components into four categories. The columns are the traditional safety and non-safety related categories, and the new information that comes from PRA and the expert panels, is whether the SSC, Safety Significant or not Safety Significant. And, of course, we have RISC-1 through 4. The subject of today's discussion is only the categorization scheme, not the requirements of going to each box.

I think it's worth reminding the Commission that we wrote a letter about three years ago on this subject, where we agreed first that safety related and non-safety related categorization should be maintained for a number of reasons. But we also pointed out that importance measures have limitations. In fact, I think that was the most mathematical report you ever received from the ACRS. And these limitations should, in fact, first have be studied by the Office of Research. And second, they should be communicated to the expert panel when they make their decisions.

In the report we sent you last March, we repeated our request that, or our desire that the Integrated Decision-making Panel, the IDP, or the Expert Panel, should be given explicit criteria how to make decisions, and those should include some of the limitations of the importance measures and the uncertainties involved. And they should include risk metrics out of CDF and LERF, such as late containment failure and inadvertent radionuclide release.

Now why should they do? Well, because on the next slide, we are speculating that if we do a better job in the PRA, and we include those metrics, then perhaps we will not need to debate what to do with the RISC-3 components, and systems and structures forever, because people will have better or a higher degree of confidence in the categorization scheme. And this is what I'm saying on slide 24.

We also recommended that materials degradation should be considered by the panel. And in addition to that, they should consider whether the SSC acts as a barrier to fission product release, maybe during severe accidents, or under normal condition as the next slide says, and whether these SSC's relied upon in emergency operating procedures. As you know, the panel can always raise the significance of an SSC, they can never lower it when they receive the recommendation from the PRA.

Slide 27 deals with something that perhaps the commission will hear us talk about again and again because it comes up in many different contexts. This has to do with the rigor that goes into the PRA and the risk assessments. And we have two examples here. One is the treatment of uncertainties which we believe should be done according to state of the art capabilities and the existing codes. It's a trivial matter now to propagate uncertainty parameters. We should be doing this rather than focus on modern uncertainties, which are much more difficult. Also we hear a lot about people are using approximate methods of and why are they approximate, because everybody's doing it. We would like to see some studies that establish after a rigorous investigation that these methods are indeed approximate and we all understand when they apply and by how much they approximate the real thing.

Now, why is this PRA rigor needed? Well, in addition to helping build public confidence, which is of course one of the strategic goals of the commission, we have another benefit on the next page because we know there are several groups within this agency that still view PRA and risk informed regulations with skepticism.

And we believe part of the reason why there is this skepticism is because the PRA's don't appear to be -- in some case, not always, some cases -- rigorous and disciplined like any technical endeavor. And the example is the last bullet here where we saw in on of the recent documents relevant to this option 2 from NEI, that there was absolutely no mention of uncertainty analysis, however they recommended some sensitivity studies at the end in lieu of uncertainty analysis, and we just disagree with that. We believe, as I said earlier, doing uncertainty analysis at the parameter level is something that should be done routinely.

And another thing that does not help building confidence is when we see the recommendation on slide 29 where the issue really here is that we're dealing with special treatment requirements whose impact on the failure rates is not known. We don't have models that would tell us that if I remove a requirement, something happens to the failure rate. So the way the first applicant, South Texas Project, handled this was to increase all failure rates of all components by a factor of ten and then look at the impact on the CDF. They concluded that it was very minimal and this committee went along.

I want to point out that one of the reasons we went along at the time was that this committee had been impressed with the PRA that the South Texas folks had done. We thought it was a state-of-the-art PRA and they deserved credit for it. But then we received the NEI document a few months ago and it says a factor of ten is too high. They don't say that. They say without any justification that I can recall, that now we should use factors from two to five.

Now, this committee, again several years ago recommended somebody should undertake an investigation to understand the impact of these special treatment requirements on the failure rates. That was never done. That's why you have the situation now where these factors appear to be arbitrary. And it's up to the reviewer to say, yes, this is reasonable or not. So that concludes my presentation and the last presentation is by Dr. Ford on PTS.

DR. FORD: Good afternoon. As you know rule 10 C.F.R. 50-61 addresses phenomenon of a crack being initiated on the inside of a radiated pressure vessel, propagating, arresting, or going through the wall and it gives certain screening criteria as to the toughness of pressure vessel as to whether we can mitigate that possibility. If a licensee can't meet that criterion then he has got possibility of using Reg Guide 1.154 to illustrate for his specific plant that he will not rise above a frequency of a through-wall crack of $5x10^{-6}$. Now, that's the current situation.

Now, as we look at how the technology has developed over the last 20 years we've got a fair amount of information to think that those screening criteria might be overly conservative. And I have to apologize for the first typographical error in the slide because I give here a list of some of the reasons for that believe that there is an over conservatism. The first is that there are less frequent thermal transients. The second reason is that there is a better operator performance. We've got tougher reactor vessel steels. We've got smaller cracks.

And all of these lead to the possibility that we may have an over conservatism in the current rule. Therefore the research community has undertaken the development of a methodology to define the frequency of through wall contracting that is more realistic given the new data, operating experience, and other techniques that we have. And this is in line with the risk informed regulatory basis that we currently are trying to promulgate.

The approach is based on an integrated approach using probablistic risk assessments to assess the frequency of operational events which could give rise to pressure and temperature transients, especially in the down comer region adjacent to the pressure vessel wall. Thermal hydraulic analysis to translate that pressure -- to define those temperature and pressure variations, transients and to give rise to thermal stress in the pressure vessel wall, and finally, a probabilistic fracture mechanics assessment to quantify the likelihood of crack initiation propagation arrest or propagation through the wall as a function of operational parameters such as radiation, transient, et cetera, fluid distribution, which will give rise to thermal stress in addition to the operational stress, the pressurization stress. So if you take the thermal hydraulics input and the probabilistic fracture mechanics then we'll get a conditional probability of a through wall crack, multiple that by the frequency of operational events then you'll have the frequency of having a through-wall crack.

This whole project has really impressed us. It's multi-organizational, not only within NRC, but without. It's multi-art. It is extremely well organized and managed, and quite honest, it's a joy to be studying it from our point of view.

Now the ACRS has been involved in this since -- has had briefings since the year 2000. We've issued letters to Dr. Travers, and earlier this year we had a very full briefing from the Staff on this issue, so obviously, this project has not finished. It's ongoing, so this is really a progress report of what we think about this very multi-dimensional project.

The nice part of this is that it is being applied or demonstrated on four plots, and the choice of those four plots spans the reactor designers, and therefore, reactor design, material, operational conditions, and They span a range of estimated end-of-life fracture toughness for the steel, so we can apply this methodology, and we should see a rational change in the predicted frequency of through wall cracking. Now so far, we have been briefed just on Oconee Unit 1, so our comments are confined to that particular reactor and predictions.

There are a number of parameters and actions which can give rise, which can influence the change in the frequency of through-wall cracking according to the methodology as it is currently developed. On this slide, I start to give some of them, and it will be continued on the next slide. For instance, there's more up-to-date PRA methodologies. There's human reliability data from, for instance, ATHENA. Because of computer power and PRA techniques we have much more, wider analysis of all the operating transients. For instance, for Oconee, nearly 200,000 transients have been evaluated and binned, and which are then passed on to the thermal hydraulics group.

In the thermal hydraulics group, we are now able to look at not just main steam line break, which is the original event of concern for PTS. We can look at other secondary side incidences, events, steam generator tube rupture, and also primary side events.

The other thing that has changed since the 1980s when the rule was originally promulgated is that we have a much, far more in-depth fracture toughness modeling capabilities using the Fava Code (phonetic) developed at Oakridge National Labs, and that has

been updated to take into account radiation modeling, crack arrest modeling, and take into account probabilistic aspects of those physical phenomena.

We have data to show how flaws, in fact, vary through the crack, and for the wall thickness. We don't have surface defects, which has a big impact on the fracture toughness evaluations. We have better estimations of the spatial distribution of the fluency through the bulb, and that has an affect on crack arrest. And so we can look at all these parameters which can change the frequency of through wall cracking, and there are three which stand out as having a major sensitivity on that frequency. First, is the toughness model. The second one is the spatial distribution of the fluency and flaws. And the final one is human actions.

Now human actions especially have an impact on which are the dominant operational sequences which affect the through wall cracking frequency. No longer is it believed that secondary side operational events are dominant. It is now, we believe, at least for Oconee, that is the primary. And for instance, the safety release valve closure times, and that is backed up by operator training, and evaluations of the actual conditions, and in the Oconee operating staff.

Now needless to say, because of the depth of this program, we've had a lot of questions. And it's not because we don't believe the methodology. It's just because it's, quite honestly, exciting. There's a lot of technical things here which are really interesting.

The three areas that most of our questions have focused in on, one is the human performance. Second one is the calibration of physical models, which are having the biggest affect on the frequency of through wall cracking.

For instance, the curbation of Relap-5 Code. We went out to Oregon State where They have an Apex Facility, which has been modified to take into account PTS transients. Physical models or material composition affects on irradiation hardening, and the flow distributions. Needless to say, there's been a lot of questions about the treatment of uncertainty, both epistemic and the statistical treatments. But as I stress, all these questions are not because we doubt the fundamental goodness of this approach. It's just that it is very exciting.

The work is ongoing. As I say, They have completed Oconee-1, and they've still got to do Beaver Valley, Palisades and Calvert Cliffs. And those are going to be very interesting because They do have very different end-of-life estimations or radiation hardening. Question about external events.

Finally, we're looking primarily so far at making the assumption that if you have a crack through wall, there's enough kinetic energy in that crack to have a big crack, and there would be a distinct possibility, if not certainty, of core damage. The question then is what the affect on containment integrity, and the impact that that would have on LERF and how that would be defined in terms of Source Terms, et cetera. And what would, therefore, be an acceptable frequency of through wall cracking. And we have been involved in all these discussions, in fact, just earlier this morning on that latter item about what is an acceptable criterion for through wall cracking.

The final graph or slide relates to whether our conclusions are as we sent to Dr. Travers in February. First of all, we find that the project is extensive. It is technically sound, and parenthetically, is exciting. We find the preliminary results relating to Oconee are very significant, in that They show that the frequency of through wall cracking is an order of two magnitudes below that which is currently defined by Reg Guide 1.154.

If that general behavior is shown with the three extra reactors, Beaver Valley, Palisades and Calvert Cliffs, then there's a sound rationale for modifying the current 10 CFR 50-61. Thank you.

DR. APOSTOLAKIS: Thank you, Peter. Back to you, Mr. Chairman.

CHAIRMAN MESERVE: As always, I'd like to thank you very much for very helpful presentations this afternoon. I think it's Commissioner Dicus' opportunity to go first.

COMMISSIONER DICUS: Okay. Thank you.

CHAIRMAN MESERVE: We rotate the responsibility.

COMMISSIONER DICUS: To go first. One of the things that we discuss with the Staff from time to time in all aspects of what we do, especially when we're doing something that we've done before and we're doing more, and more and more of them, as in license renewal, is to tell us what sort of efficiencies that they're beginning to recognize, and how They can start doing things better, faster, whatever, to recognize those efficiencies. So my question to the ACRS, now that you have reviewed several of these renewals and the activities of the Staff, what efficiencies is the ACRS recognizing in your activities?

DR. BONACA: That's an interesting question, because recently we have been discussing among ourselves what role we are going to play. In the early time of license renewal, we were engaged on the process. I mean, process affects scope, screening and so on, and so therefore, it had a technical significance. And I think the appropriate definition of this process was important, and I think we participated in it actively.

Right now we are involved in more reviewing, the degree to which the Staff is going through the steps of verification. And so we don't want to be just involving ourselves with purely, you know, double checking because we cannot be as efficient and effective as the Staff can be. They have many more resources than we do.

In so far as our effectiveness, we have, as you know, divided our sub-committee into two. We are essentially spending pretty much the same amount of time in review of the applications, and the SERs. But also, we are now going to write an interim letter which is time consuming for us, and we see as unnecessary, unless there are some specific issues that we're going to raise on the proposed, you know, meeting at SER, and I think this is going to improve our efficiency, in fact, and effectiveness in so far as, for example, this meeting. We have reviewed the North Anna and Surry application. We do not plan to spend any time on the main meeting agenda to again review this with the whole team. We just expect to see the closure of the open items and then to review them at that time.

We still have a role to play in some ways. For example, we have seen some of the latest applications to come with less detailed technical information, and we have pointed this out, that it's a concern for us when we cannot make a judgment regarding margins, for example, from time limited aging analysis. It is important that we have sufficient information to be able to compare to criteria, and to make a judgment on whether or not we feel the margins are there or not. The tendency right now is to go by a process which is so well established that at times there isn't very much information, so that's probably the role we can play at this stage. Again, not one of repeating the same steps of the Staff, but doing that kind of verification.

COMMISSIONER DICUS: I want to follow-up on that, because this morning when we were hearing from the Staff, there was a statement made, if I recall correctly, that the applications are generally getting better. And now you're somewhat, apparently, concerned about the level of detail, so I need to just be prepared a little better.

DR. BONACA: Yeah. First of all, the latest application that we saw is very well structured and organized. Clearly, They are following now a very established process. The NEI Guidance is clear. They're following the guidance, and the applications are very easy to review. That application was impressive.

On the other hand, information hasn't been provided on the time limit of aging analysis in so far as the results of the calculations. Okay. They have said we performed the calculation of the PPS for this plant at 60 years, and it meets the requirement, or say meets the criteria period. So, therefore, the application doesn't contain the information. The SER does not discuss the difference between the value and the limit. We have felt that the information should be in the application, so to a very high degree, the structure of the application is better, but there is some elements that really have to be worked on, in so far as the level of the information provided.

COMMISSIONER DICUS: And, obviously, you're discussing this with the Staff.

DR. BONACA: Yes. In fact, we had a meeting today at lunch time before this meeting to point out that we would like to see more information, and if the Staff needs our help to make sure that the license is provided, we'll put it in a letter that we would like to see some of these results in the application.

COMMISSIONER DICUS: And the second part of this question before I got sidetracked a little bit on Part 1A-B or whatever, had to do then -- I was curious as to whether or not you still thought you needed two sub-committees. And I think you've pretty well said yes, you think you do at this stage.

DR. BONACA: Well, there are so many -- as you can see, this year we have four applications coming through between now and December, and They are multiple plants. Just the number of plants involved in all applications is already -- keeps us busy. So if anyone of us will have to chair one of the sub-committees, he will have no time to do anything else. I mean, so that's why I think it's appropriate that we have two sub-committees working on it.

In the future, we may review our involvement. If it becomes something very well organized, and issues not consistently repeated, et cetera, we may not need full involvement of ACRS, but we will provide that recommendation another time.

DR. APOSTOLAKIS: We will still write a letter though.

DR. BONACA: We will. But I'm saying some level of -- I'm only talking about in the future, we could become as efficient as that, but I don't think that probably we want to go that far.

COMMISSIONER DICUS: In slides 10 and 11, you talk about the future Committee activities where there are 10 items listed. As you went through these, you spent a little more time on some of them, than the other. Have you prioritized them, as obviously some of these are going to take a greater percentage of your time, or are you to that point yet?

DR. APOSTOLAKIS: No, I don't think so. I don't think we've prioritized them. Some of them we have taken the initiative, so obviously, we think they're very important. But others --

COMMISSIONER DICUS: Which ones?

DR. APOSTOLAKIS: Others we have to review. And it's --

COMMISSIONER DICUS: So at some point though, you may prioritize them, or no?

DR. APOSTOLAKIS: I don't know what that would mean though, to tell you the truth. I mean, if the Staff is preparing something that will eventually come to you, and we have to review it, we have to review it.

COMMISSIONER DICUS: Okay.

DR. APOSTOLAKIS: We can't, you know, it's low on our priority list.

COMMISSIONER DICUS: That's fair enough. On risk-informing Part 50, some people say we're going way too slow. Some people say we might be going too fast some places or the other. Can you talk to me a little bit about the rate? Are we where we should be, or no, or?

DR. APOSTOLAKIS: Well, I think that the reason we're not going very fast is that key groups don't think that PRA is adding anything. And I -- and it's related to some of the arguments that Dr. Kress and I made earlier.

I think the state-of-the-art can give PRAs, if they're submitted to us, and the various documents if they're submitted to us, can raise their rigor and discipline approach. Unfortunately, this is not happening, and people don't realize that They may get relief or, you know, avoid some requirement now, but they'll pay the price later, when the Staff will not believe them. So, you know, the late containment failure is a good example, you know. We are told stakeholders didn't want to hear about adding that as another method. And if They win, then eventually they'll pay the price somewhere else, because the Staff will be concerned about it. Whether we put it in the metric or not is a detail, but it seems to me that if we raise that quality of the PRAs, then maybe we will see better progress.

Now I'm not saying that that's the only reason, but I think that's a major reason why we have slowed down, unless my colleagues want to add something.

COMMISSIONER DICUS: They're awfully quiet. The one final question, on slide 16, you talk about the over-arching policy issues, and the statement, "The Implementation of the Commission's Expectations." Does the Commission need to be sure that Staff together -- obviously, we need to be sure, but do you think that the Commission should better define, or needs to re-look at expectations to ensure that the Staff, as well as the ACRS, knows exactly what those expectations are?

DR. KRESS: Well, that was our feeling. We didn't come to an agreement or a Committee position on that, but our feeling was that that needs better definition because you know that new plants are going to come in at a much better safety status, based on risk metrics.

The question involves whether or not a plant could come in that's just as good as They already are, but not much better. That doesn't meet your expectation because you want the new plants to be safer, more passive components, so the question is what is the real expectation? Do They have to be -- how much safer do They have to be?

COMMISSIONER DICUS: Okay.

DR. KRESS: It may not be a problem because the new plants designs that I've seen are generally considerably safer in the sense of what we know about the risk status. It's the intermediate plants that give you some concern. I don't like to name plants, but the AP1000. You know, it has a better safety status, but it's not orders of magnitude better.

It has much more reliance on passive features than -- but there may be some question about some of its defense in depth status, so it's those issues that just how much better do we think these plants ought to be. And the thinking is well, if you have one or two plants, maybe it doesn't matter that much. But if you're going to have a lot plants, then maybe it does, and so I don't know how you address that issue.

DR. POWERS: Commissioner Dicus, I can report to you that at the recent ANS meeting, there were a couple of panel sessions on discussing safety of advanced reactors, and in both of those, the question of what the Commission's expectations were with regard to safety margins arose. And it was clear that there were multiple interpretations of the words, but the focus came down to is there -- does the Commission have particular ideas in mind concerning the relative balance between prevention and mitigation when it asks for these improved margins. And that speaks clearly to some of the design options that people are pursuing in these advanced reactors.

Any clarification that you might offer about it would certainly help the designers, in that it's not so much the magnitude of additional safety. I think most of the reactors are coming in with very high safety goals, but They do that in an economic sense that requires them to make some judgments about the balance between mitigation and prevention.

And clearly, if you're the owner and buyer of a plant, you want to put a lot of funds into prevention, because you'd just as soon not lose your plant. And if you do that at the expense of mitigation, they're wondering if that is an option that would be acceptable to the Commission. So to the extent that the Commission can clarify things on that, I think that would be a big help to designers, and people evaluating the plants, of course.

COMMISSIONER DICUS: Okay. I guess we have some marching orders then. Thank you, Mr. Chairman.

CHAIRMAN MESERVE: Commissioner Diaz.

COMMISSIONER DIAZ: Thank you, Mr. Chairman. As you see, I'm losing my voice, so you're in good shape. Having said that, let me just make first a comment that it seems like years keep going by, and I keep fighting to try to get some consistency in the way we address things. And I find myself with the -- our ACRS and our PRA groups still putting in the viewgraph Risk-informed Performance-Based. The Commission keeps saying it's risk-informed and performance-based. And we keep saying this, could you pretty please? Because if you don't do it, see everybody is going to say ahh, see ACRS has decided it's Risk-Informed Performance-Basis. We might as well get some consistency on that.

All right. Now let me continue on that issue of the safety, because I think that's a fundamental issue. And by the way, George, I don't think, but I would agree with you that the discipline and the rigorous, you know, approach to PRAs have a lot to do with whether we are capable of developing a risk-informed regime and the speed at what it goes, and I think we are looking forward to the next few months to see whether we can get some better standard. But that is a crucial issue. There is no doubt it.

Going back to the issue of the -- how safe is safe. This is something that, of course, we sometimes find that our hands are tied. We cannot demand things that, you know, maybe in the law are clearly said that, you know, once you have reasonable assurance, and what has been established. And, however, we did see with the certification of these advanced reactors that They all came much better. And, of course, the issue is do you set up the standard at that level, do you set it below?

I don't think we have solved that issue, and I think that that's -- if we're going to get new orders in this country, I think that's one issue that needs to be resolved. And I don't know how much you guys have thought about it, but if there are any leading thoughts on that matter, I certainly believe it's time to put them on the table, because, you know, I don't think we are clear. I am not clear in which way we are going to go.

I think that we are accepting the fact that they're better, and saying they're better. You know, does that mean the margins are correct? Does that mean people have been able to set them down and quantify them, and put them in your -- you know, in the proper risk metrics. And I think eventually, a development of new reactor economy will have to have risk metrics and economic metric, and I think it might be worthwhile to do that. Have any thoughts on that matter, additional thoughts?

DR. KRESS: We certainly have been thinking of those issues. We really don't think you have in the regulations a quantified level of safety acceptance. You know, you have your adequate protection but that's not really quantified.

The safety goals don't have the force of regulation, except in a few minor places where They show up in cost benefit regulatory analyses, and in the Reg Guide 1.174-type places. It's used as guidance, and it's beginning to show up in the framework that's being developed for Risk-Informing Part 50, but these are all guidance on how to craft the regulations.

At one time, the ACRS suggested that there ought to be a quantified acceptable risk level applied to each plant, that that would give a coherence to the whole system. And I think we still adhere to that suggestion. And the question is, then what would that be? Is it current safety goals? Is it some quantification of adequate protection, which is probably lower than the safety goals already, so you're already -- your regulations already give you license, I think, to have a quantified risk metrics that's more than the safety goals, because I think adequate protection is a lower level.

We still think there is some need to define a set of risk acceptance metrics that covers the full set of objectives you have, and those objectives don't just include CDF and LERF, as we said many times. It includes all levels of release, ordinary releases. It includes land contamination. And you're certainly concerned with total fatalities, and with safety goals actually. And we think you need a set of risk metrics that cover the whole shebang, and we believe that those can be captured with the frequency consequence concept which has been endorsed by IAN, and we suggested it one time.

We think you should have a coherent, consistent acceptance criteria in the frequency consequence dimension that we do look for. You know, the question is if that's just a concept, where do you set the line? And that's a value judgment. That's just how much risk is the country, the public willing to accept for the benefits They get from nuclear. And that's the thing you wrestle with with the safety goals for -- you know, that's what we beat to death.

And there's no real way to arrive at something like that without -- you can't take a poll in the public and find out what risk they're willing to accept. And we don't really know how to quantify the full benefits of nuclear, so my suggestion was that you start from the safety goals, and the prompt fatality one is probably the most limiting one. But in some cases, the land contamination is more severe. And try to decide on what the cost of having -- if you were to have an accident that met the prompt fatality safety goal, what would that cost you? And the metric that's in common with all of these things is money, so frequency times consequence, where your consequence is money, in a sense price, but it's a way to -- it's a technical way to get coherence in there, is a concept that would give coherence to the whole frequency consequence range.

You may have to put in -- you may not want the product to be constant knowing the whole frequency range. You may want to put some risk aversion in, but I think that's a way to start. And I would probably start with the safety goals, but I would adjust them a little bit by saying it must be met with some level of confidence. And that works in your uncertainty issue.

DR. APOSTOLAKIS: I have a couple of things.

DR. KRESS: Okay.

DR. APOSTOLAKIS: One is the adequate protection determination is based on a lot of things. Why should the risk-related acceptability determination be based only on core damage frequency? If you want to replace the system, you have to worry in the risk arena about the things that we worry about here. And definitely, we don't worry about core damage only. We do worry about it, of course, but that's not the only thing.

And the reactor oversight process has demonstrated that very clearly, where we say there are cornerstones, initiating events, and so on, that we do worry as an agency about the frequency of initiators, the unavailability, unreliability of mitigating systems, and so on. So there is really a need to take what the Staff and the Commission, of course, really worries about in the traditional regulatory structure, and see whether we can take that over to the risk arena. And if we decide that some of it doesn't belong there, then we'll make a conscious decision not to transfer it there.

And the second point, I think Dr. Kress emphasized the need for acceptability criteria and how to do that, but we cannot ignore the capability that we have as an industry to quantify risks. And the emphasis, I think, so far has been on quantifying defense in depth measures. You have one out of three, or one out of two. We know how to handle that. Safety margins, we don't know how to do that.

I mean, we have some ideas, but has anybody really tried to do it, and bring it, you know, before the Staff, and scrutinize, you know, go through the process? And I think until we do these things, you know, there -- we limit ourselves to core damage frequency and risk-informing the regulations, which means now a lot of things to a lot of people. Not always the right things, by the way.

COMMISSIONER DIAZ: Okay. Talking about quantification on your slide 26, Dr. Apostolakis, whether failure of SSC results in an inadvertent radionuclide release.

DR. APOSTOLAKIS: Yes.

COMMISSIONER DIAZ: Could you quantify that for me, any radionuclide release?

DR. APOSTOLAKIS: This relates to what I just said, that you know, again licensing a plant, you don't just worry about severe accidents. You just don't want releases, and I think Part 100 covers those. So that what the point we're making here is that when you do this categorization, you have to worry about that too, because the categorization that is based on importance measures, of course, relies on your CDF and burn. This is the basis, and that's really the point of this.

COMMISSIONER DIAZ: Yeah, but it should be some quantity, don't you think? I mean, it could be any small -- are you going to protect it?

DR. APOSTOLAKIS: The first question is, let's agree to do it, and then we'll have to worry about that. Not any, no, no.

DR. BONACA: I would like just to add one thing. In part, I think what we have discussed here is also tied to the issue of defense in depth. Okay? I mean, the whole greater the protection, which is to implement safeguards which are commensurate to the frequency of initiators and the severity of the consequence have an intent also of defense in depth, because it puts -- and to some degree, to just ignore the contribution of some of those components which do not prevent core damage, but essentially provide some level of protection, it's a concern.

COMMISSIONER McGAFFIGAN: I think the Commissioner's point was you don't have to worry about that. We want to worry about minimal, but not --

DR. KRESS: I think it was the frequency consequence dimension.

DR. APOSTOLAKIS: Yes.

DR. KRESS: Because if it's a very high frequency but a low consequence, you know, you want to do it. But if it's not very frequent and a low consequence, then you don't.

CHAIRMAN MESERVE: Commissioner McGaffigan.

COMMISSIONER McGAFFIGAN: Thank you, Mr. Chairman. I think I've had more of the Commissioner discussions with Staff -- not that the presentation was bad, but I think the questions have been great.

I'm going to go back to Mr. Bonaca, and your conversation with Commissioner Dicus. This notion of getting information on the time limit and aging analyses, I vaguely remember a letter to that effect before that you guys wrote that there needed to be more information in the license renewal applications. I remember sort of asking a question at one point, well gosh if the staff came back with their lessons learned, should we require this. And you all said no, no, no, we can work it out. And the staff said no, no, no, we can work it out, but is my recollection wrong?

That this issue of the amount of information that you're getting about the results of the time limit of aging analysis has been a

couple years now.

DR. BONACA: I think it was a broader issue at the time as how much information that would be in the application and that was being debated because you may remember that the industry took the position that They were taking credit for existing programs, there should be no demonstration for those, no information provided so it was broader in that context. Now I think those issues are pretty much resolved.

COMMISSIONER MCGAFFIGAN: So it's down to the time limit and aging analysis results.

DR. BONACA: Well in my judgment it is. You have a lot of other components for which you a program where you inspect and your corrective action program has to come in. But I think where you have a component like a vessel that is supposed to be there for the life of the plant and you do a calculation to see how far you're going to get in 60 year, you would like to know what kind of margin you have. Some plants have a lot of margin, some plants have very little. I think it would be a good piece of information to have.

COMMISSIONER MCGAFFIGAN: If you want to send us a letter that basically says that you're going to ask this question every time an application comes across your desk people would probably speed to up the process a little bit by including the information, otherwise the 21 month goal for getting these things reviewed could be at risk. I would think that might clear a few minds and get you the information that you need. So I'm all for that.

Dr. Apostolakis, you talk about quality of PRA. And I'm with you. Commissioner Diaz, Commissioner Dicus are all with you. We need to have high quality PRAs, the Chairman I am sure, too. The question is, are we headed toward a train wreck with what is coming in?

I mean, you were quite critical of an NEI document that's floating around. I don't know whether the ASME proposal really deals with this uncertainty analysis in a way that would make you comfortable.

Are we going to end up with something that doesn't meet with what you think is needed in a way of a high quality PRA for going forward.

DR. APOSTOLAKIS: Well this committee will object to any attempts of adopting documents, whatever they're coming from, that are not technically sound. But I think -- I don't know if it's going to be a train wreck but I think the result is what was pointed out earlier. People will not believe in it. Our own people will not believe it. People in the industry will not believe it. And the whole effort for risk informed regulation will stop.

COMMISSIONER MCGAFFIGAN: We've been going down this course of endorsing an ASME standard that has been the result of intense negotiations between the staff and the industry for a multiple number of years with, I'm sure, numerous compromises buried in the fine print. Should we have thought about a different approach then just requiring a high quality PRA as a prerequisite for at least -- I mean, you know, at least for some, if you're going to do the revised 50 blank, 50-69, whatever, you need a high-quality PRA with the following characteristics?

DR. APOSTOLAKIS: I have great difficulty understanding why the industry does not have a good Level 2 PRA for every unit out there. I just don't understand that, and I think I'm not alone not understanding it. It's just beyond me. They have done the IPEs. They have done the IPEEEs, so a lot of the work has already been done. We are told that they have already upgraded a lot of the IPEs, so going to a complete Level 2 PRA should not be that much of an effort. And yet, every time we say, you know, do this or do that, there is always resistance. That's beyond me. I really don't understand that, Commissioner.

COMMISSIONER McGAFFIGAN: I may be representing the lowest common denominator, rather than --

DR. APOSTOLAKIS: It does not help at all.

COMMISSIONER McGAFFIGAN: But that gets -- the quality of the PRA issue gets to -- you know, if you don't believe them, and I don't believe them, and you all taught me to not believe the total numbers in any of these PRAs, to believe, you know, the deltas maybe, but not the totals. Is there a finite number of decades required to get to the point where you could use these frequency consequence curves in a way that Dr. Kress was talking about earlier, and have some faith in them?

DR. APOSTOLAKIS: It's not a matter of using CDF or the frequency consequence covers. I mean, if --

COMMISSIONER McGAFFIGAN: Yeah, but it's garbage in, if the whole --

DR. APOSTOLAKIS: Yeah, that's right. That's the issue.

COMMISSIONER McGAFFIGAN: If you can't believe the total numbers to within a factor of two, or three, or ten, then what -- you have -- how does it work? Are we starting to have quantitative arguing, we've argued before, are quantitative risk metrics.

DR. KRESS: Well, the thrust of our arguments is that along with completeness in the PRA in terms of treating all modes and all events, you need to have a pretty good handle on the uncertainty. You have to do it. Now that gets you out of this quandary of

believing the bottom line numbers because it tells you how good they are if your uncertainty analysis is correct, or believable. And your acceptance criteria should have some relationship to that confidence level you put in the number, so that's why we keep talking -- you can't just use a PRA and get one number out of it. You have to have the uncertainties in the distribution, and you have to deal in uncertainty space in terms of confidence levels. And we think that can get you out of that.

COMMISSIONER McGAFFIGAN: So it's more than a Level 2 PRA.

DR. KRESS: Oh, yeah. I disagree with George to some extent on that. I think you need to go to Level 3s, but you know, there's disagreement in our committee, but I think --

COMMISSIONER McGAFFIGAN: No, I don't think he disagrees with you about Level 3. He just says he's just surprised that they don't at least have Level 2s today.

DR. KRESS: The focus, in my mind, ought to be on how do you do this quantification of uncertainties. You know NUREG 150 was like two or three root canals, and that dealt with the knowledge uncertainties. We can do parameter uncertainties very nicely, so I think we need to focus on how best to do that, and how to incorporate that into the thinking and into the PRAs. And you also have to talk about how to deal with the completeness issue, because I don't think we do very well with fire PRAs right now. Pardon my Tennessee using of fire, but I think Commissioner Dicus will probably understand that. You know, that's my view.

COMMISSIONER McGAFFIGAN: Okay. Let me just ask a couple of more questions. On Power Uprates, Gary Hollahan, I think, came this afternoon, just in case I asked this question that I asked this morning. He's nodding his head. He told me that in the elevator. Are you guys happy with where things stand? You sent us a fairly strong letter in March with regard to the need for continued research on high-burnup fuel, particularly in the 55 gigawatt day per -- 55 to 62 gigawatt day per metric ton heavy metal, and you felt that they've been relying on engineering judgment, and They were canceling the program that was going to help them confirm their engineering judgment. Is that -- and the Staff has promised us, according to Mr. Hollahan this morning, that there's a comprehensive effort underway to re-look at the high-burnup research program, and give you something along the lines of what you were asking for. Is that in good shape?

DR. POWERS: Not in my estimation, it isn't. The situation is that, and NRR has indicated that no one has a user need for the research underway in RES for looking at the performance of a high-burnup fuel under design-basis accident conditions, and severe accident conditions. We didn't quite understand why They would do that, since that did seem to be a crucial issue for a number of licensing considerations. And we asked them for the information. They have given us a briefing outlining some of their positions and thoughts on the subject that only left us more confused, because They seem to be adopting criteria that, at least on the face of it, didn't seem to be what They wanted to adopt.

My understanding is that they're still organizing among themselves where NRR stands with respect to that research program. I am repeatedly told that NRR is supportive of the research program, but not to the extent that They would issue a user need. I find that puzzling.

Now the question on high-burnup fuel, where do we stand? And even beyond that, what do we know about high-burnup fuel in some of the modern clads for which we have no experimental data. And their response under accident conditions, I believe the research program is going well. I mean, it's a difficult research program because these are experiments that necessarily you have to have high-burnup fuel, so you -- it takes a while to get the fuel, and it's hard to deal with. But I think it's an area that affects a large number of regulatory processes.

We even saw one today in discussing Reg Guide 1.174, that in fact, They have to introduce caveats into their 1.174, alerting people to the possibility that acceptance criteria might be changed as a result of this research. So to argue that there isn't a user need in NRR for the results of this research is one that the Committee has asked for some explanation of, and we have not gotten that explanation yet.

COMMISSIONER McGAFFIGAN: I've got one more. Actually, I have several more, doctor. I'll limit it to one. Dr. Apostolakis, I thought you just -- after, I think, you had gotten a briefing, an initial briefing about the potential color of the Davis-Besse event and, you know, which is the only INES-3, I think, in any advanced country in the past 12 years, you know, in terms of how INES scores the event. There are press reports that, you know, our region are struggling. And I don't know no more than the press reports in this instance as to how to color the Davis-Besse event, and Mr. Lochbalm has written in saying, you know, it would be incomprehensible to the public if it's anything other than read. But the Staff -- you know, you're Mr. Risk-Informed, you know, is going through it and saying okay, the initiating event, according to the press, the initiating event probability is not high but, you know, this half-inch layer of steel is fortuitously there, you know -- it wasn't design for this event, this half-inch layer of steel which is defense in -- you know, shows how much defense in depth we have in some of these plants, more than we even knew. You know, means that the initiating event frequency is very, very low. Therefore, you end up, you know, green, no color, or something like that, following by the book. So I think if you, as Dr. PRA, could you tell me, if you were the person trying to analyze the Davis-Besse event, what color you'd get to on your own -- you know, whatever metrics you think should be the ones we use in a risk-informed reactor oversight process.

DR. APOSTOLAKIS: Well, I -- let me tell you, I don't know what color. I would definitely not come up with green. And if somebody did that, I would be very anxious to find out why.

COMMISSIONER McGAFFIGAN: Okay.

DR. APOSTOLAKIS: As you probably gathered from the meeting I had with you, I was really shocked by what happened.

COMMISSIONER McGAFFIGAN: But how do you -- you know, the arithmetic may be forcing people into green. What is wrong with the arithmetic? Is it a flaw in our reactor oversight process or the STP process where something that is obviously a fairly big deal by, you know, what do you call it, structuralist criteria, you know, ends up among you rationalists as maybe not that big a deal.

DR. APOSTOLAKIS: Well, first of all, I'm not sure how rationalist I am any more.

(Laughter.)

COMMISSIONER McGAFFIGAN: This is music to my ears, by the way.

DR. APOSTOLAKIS: Well, I'll tell you first of all, if we -- indeed the approach we're using now comes up with green, then there's something wrong with the approach. We are not using the right criteria. We're not using the right --

DR. POWERS: Well, I mean, I think it should speak to the specifics of some of the areas that we talked about even today, about where PRA needs to evolve in order to properly deal with these things, such as the -- more treatment of passive components, the treatment of aging phenomena, treatment of increased failure rates as a result of the higher demand.

COMMISSIONER McGAFFIGAN: Yeah. I'll just let the public -- this commissioner will also have a hard time not understanding anything other than red for the Davis-Besse event. I mean, we had read at Indian Point, which was an INES-1 event, and which the researchers come along afterwards and said, you know, we're having a hard time, you know, finding any conditional core damage frequency or whatever there, and so a relatively straightforward tiny leak in a steam generator generates a red, and here we have an eight inch hole in the reactor vessel --

DR. APOSTOLAKIS: Unanalyzed.

COMMISSIONER McGAFFIGAN: Unanalyzed, and it's coming up something other than red, but I --

DR. APOSTOLAKIS: All right. Let me give you another idea we discussed this morning. I mean, in the famous diagram of the integrated decision making process where have the inputs defense in depth, safety margins, little PRA here, monitoring, if the idea of risk-informing the regulations is to supplement risk information with other things, then what Davis-Besse is telling us is there should be a sixth box, safety conscious work environment. How about that? Because that is a major, major, major thing we need.

Now it's premature to speculate how we're going to handle it, but we definitely have to do something about it. And I don't think the solution is only the traditional technological kind of solution.

COMMISSIONER McGAFFIGAN: Okay. Thank you.

CHAIRMAN MESERVE: Dr. Kress, I know that you -- ACRS has gotten into the advanced reactor activities with a particular focus on gas reactors because of the expectation that we would be seeing a pebble bed module reactor that we would be working on. As you know, that's sort of fallen away, at least for the time being. And it appears that we may be flooded with a gas reactor from General Atomics, but we -- certainly there's great interest in the ESBWR, and now the SWR, and maybe even in advanced CANDU reactor, so we're having some -- we're going to be seeing some light wire reactor designs, or CANDU heavy wire moderated, but light wire is the cooled.

Is our current regulatory system going to be adequate for us to be able to handle those designs, or do we -- I mean, you've had -- pressure you were going forward because you thought in a major way we're going to be dealing with gas reactors, and the question I think with the business we have is changing in this area. And I'm discouraged that we need to be thinking about different ways to do our business, but are we in quite as desperate a condition as we thought we might be in having to deal with a gas reactor?

DR. KRESS: Most of these -- a lot of reactors have a great deal in common with our current reactors. They just do it better. And I think the regulatory structure we have can deal with them very, very efficiently, you know, with some tweaking and modification, so I don't think you're in near as bad shape as you would be for some of the gas cooled concepts. And I think we need a lot of work for some of the Gen IV concepts also. A lot of those radically different.

I think we can handle the light wire reactor concepts, and that includes the CANDU, as well as the SPWR and the AP1000, and the -- now the one I think may give us difficulty, and will probably require a little more in the depth thinking about the regulations is the IRIS concept.

CHAIRMAN MESERVE: The what?

DR. KRESS: IRIS. But I still think it fits into the regulatory structure we now have, so I really don't -- I think you need to supplement it with risk thinking, but I think just using the structure we now have, you could certify those.

The concept that you need to think about, fitting it into the regulatory structure we now have, is how do you define the design-basis accidents for these particular concepts?

CHAIRMAN MESERVE: Well, you've listed that.

DR. KRESS: Yeah, I talked about that before, and I think that's the main thing pointed out for those concepts.

CHAIRMAN MESERVE: Let me ask you a question about that. And I think in slide 18, that was one of the impediments, lack of criteria for selecting design-basis accidents. And let me ask something, may be, I admit, may be a stupid question that may reflect my own ignorance. If, in fact, you had the robust set of risk criteria, why do you need design-basis accidents?

DR. KRESS: Well, that's a very good question, I think, and I've asked myself that. It's because design-basis accidents give the designer something to design to, much better than -- say meet these top level risk criteria. And it fits into the current regulatory structure. The current regulatory is basically design-basis, so if you want to fit it into the current, you need them. Now the whole -- the high level, the risk acceptance criteria, that might come in, is they help you define what these design-basis accidents need to be. You know, the Exxon people suggested to cut off frequency. I don't think that's acceptable. There's no technical basis to say you cut off the frequency, the ones that are more frequent than that will have lower design-basis and lower severe accident. That needs a better technical justification and you have to have a philosophy on what your design-basis accidents do for you. What they do for you is, if you haven't designed, you haven't specified, and you meet the acceptance criteria, which is another thing, you have to define acceptance criteria. And these currently are things like amount of hydrogen produced, and the peak clad temperature. You have to decide what those are going to be for some of the other concepts, but the philosophy is that if you specify where the design-basis accidents are, and how you meet by the general design criteria, then you will accommodate clearly things like diversity and redundancy, and the single failure criteria. You will accommodate in its provisions, but will also help accommodate the severe accident. It will help accommodate them to the extent that the whole system is rendered to an acceptable level of risk. That's the philosophy, in my mind, of design-basis accidents, so what I suggested was, okay. You go ahead and pick a frequency. You have to have enough of a design to be able to identify initiating events, and the frequency. That's a tough job right there, but you pick one, and then you make a design. You adjust your design for those design-basis accidents, specify just the way we do it now in a deterministic way, and come up with a second level design. And then you do the PRA with the uncertainty analysis to see if you meet the risk criteria. If you did, you selected a pretty good level. In fact, you may have met the risk criteria so well, you may want to up the frequency and cut off some of the design-basis. If you didn't meet the risk criteria at the right at the right confidence level you chose -- you drop your frequency down. So in my mind, that's the way you deal with it, and that's -- if you do it that way, your design-basis accidents are going to be design-specific. You're not going to be --

CHAIRMAN MESERVE: I think it raises a question that the designer may want to have a design-basis accident so he can figure out how to start. But it isn't clear to me that we need to have that as the foundation for our regulatory system. Let them start wherever they want, so long as they can come in and we have an appropriately rich set of criteria that they satisfy, why do we need to build design-basis accidents into our regulatory system?

DR. KRESS: Because it's already in the regulatory system. That's the way we review them, and it's the way --

DR. APOSTOLAKIS: I think the review also is not just the design. I think the review will be more efficient if you have design-basis accident.

DR. POWERS: I think it puts us in a trap, and I don't know how often we have to learn this lesson. The design-basis accidents give you a trap. People design for the design-basis accidents that are designing for risk. The sooner we can get rid of these, the better off we're going to be. I mean, it's the -- for these advanced concepts, it's just an excellent chance for us to say look, what we're doing is regulating risk, not regulating large breaks in piping systems.

DR. APOSTOLAKIS: That sounds too good to be true though.

(Laughter.)

DR. APOSTOLAKIS: You know, I would hate to have to have to come to the NRC Staff and propose building a big machine that costs $5 billion, and be at the mercy of a reviewer who will question my common cost failure rates. I hate that, so I won't have as much --

CHAIRMAN MESERVE: You won't have good cost failure rates.

DR. APOSTOLAKIS: -- determinism as I can. Now that determinism will be based on risk, so the risk analysis will be done separately off-line. When I have production and people review it, it has to be based on deterministic criteria, as much as possible, that have been derived from probabilistic considerations. But I would not want to be at the mercy of somebody who doesn't like my numbers.

CHAIRMAN MESERVE: This is from a guy who is otherwise selling us PRAs and all of the --

DR. APOSTOLAKIS: No, no, no.

CHAIRMAN MESERVE: We're going to take that title of Mr. PRA away from him.

COMMISSIONER DIAZ: I just woke up. Can I --

(Laughter.)

CHAIRMAN MESERVE: I'd like to -- I think we're -- this is an interesting subject, I think that we'd like to pursue with you further. I'd like to pursue the question, I think it was implicit in your answer that you gave to Commissioner McGaffigan, in that you have emphasized, George, in your presentation, your concerns about the not having uncertainty analysis, and so forth, and the quality of the PRAs. We have underway, have this effort now by ASME to develop standards, and the Nuclear Society is doing their little power shutdown standards for PRAs. And the sense I got from your answer was that even with those standards in place, you would not necessarily have confidence that the PRAs consistent low standards will be sufficient.

DR. APOSTOLAKIS: Right.

CHAIRMAN MESERVE: Is that where you think we're ending up?

DR. APOSTOLAKIS: Yes.

CHAIRMAN MESERVE: Okay.

DR. APOSTOLAKIS: Because I think one of the things that they tried to do in the ASME standard is to speculate when you need uncertainty, and when you don't, and so on. And I just don't agree with that. And in fact, we wrote a very good letter praising the ANS standard, or proposed standard on external events because they paid so much attention to uncertainty. And then we hear that the industry was up in arms because we paid too much attention on uncertainty. So I hasn't seen the final result now. But I for one would disagree if they change. That doesn't mean the committee will disagree.

I think where we ought to be by now after all of these years, we should be doing parameter uncertainty propagation and quantification routinely. And we should be focusing on what is really important: model uncertainty. That's what's killing PRA. Model uncertainty. But if we don't even mention the word uncertainty, why should we worry about model uncertainty and if I raise the issue, they will tell me, "well, how would you do it?" I don't know how I would do it. That's why we have to think about it. But if we still have to fight the battle over parameter uncertainty that was done very well in the the Reactor Safety Study, 1973, then of course we'll never handle the really important issues acceptance criteria, model uncertainty, and so on.

CHAIRMAN MESERVE: Any difference of view on this issue?

DR. KRESS: I certainly agree with George.

CHAIRMAN MESERVE: We're going to have our work cut out for us. With regard to, Dr. Ford, you emphasized that, I think your final slide, slide 38, that at least as to the Oconee analysis that the PTS screening criterion was overly conservative by, I think, you said two orders of magnitude. Is there any reason to believe that that's an outlier?

Or would you expect that this is what you're going to with finding with these other ones?

Is there anything from the analysis that could be undertaken from the Oconee case to say that that's going to be anomalous in terms of the degree of conservatism.

DR. FORD: I believe the Oconee plant is the one with the current estimated end of life toughness -- highest toughness of the four plants. So it may well be an outlier. And this is why the outcome from the next one, Beaver Valley, which I believe is the one with the estimated lowest toughness, the highest degree of irradiation hardening, is going to be very interested. It would tend to bracket what you'd might expect to find. This is why in the discussion this morning, it was emphasized by the staff that the original assertion that the current rule was conservative. It was said might be conservative. We might find a highly irradiated one which in fact doesn't show the conservatism in the frequency of through-wall cracking. But it's certainly going in the right direction.

CHAIRMAN MESERVE: All right. Well, I would like to thank you. As always, this has been a very illuminating afternoon for all of us. We very much appreciate the hard work that you put in and we greatly benefit from your advice. I would like to thank you again for participating with us and submitting your letters. With that, we're adjourned.

(Whereupon, the proceedings in the above-entitled matter adjourned at 3:37 p.m.)