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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

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COMMISSION MEETING WITH
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
(ACRS)

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FRIDAY
MAY 11, 2001

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ROCKVILLE, MARYLAND

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The Commission met with the Advisory Committee on Reactor Safeguards at the Nuclear Regulatory Commission, One White Flint North, Room 01F16, 11555 Rockville Pike, Dr. Richard A. Meserve, Chairman, presiding.

PRESENT:

RICHARD A. MESERVE	Chairman
NILS J. DIAZ	Commissioner
EDWARD McGAFFIGAN, JR.	Commissioner
JEFFREY S. MERRIFIELD	Commissioner

I-N-D-E-X

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

(10:29 a.m.)

CHAIRMAN MESERVE: Before we get started on the formal part of our proceeding, I am pleased to announce the appointment of Dr. F. Peter Ford as the newest Member of the Advisory Committee on Reactor Safeguards.

Dr. Ford brings to the Committee 40 years of experience in the power generation and materials processing industries as a consultant and manager. He recently retired from General Electric Company where his contributions included development of life prediction methodologies for structures exposed to stress corrosion fatigue.

Dr. Ford received his Master of Science degree from Rensselaer Polytechnic Institute and his doctorate from Cambridge University in the United Kingdom. I'm sure that his experience and knowledge will be a valuable asset to the Committee and on behalf of the Commission I would like to welcome Dr. Ford.

There is a certain protocol associated with these events and it does include the presentation of a certificate.

Dr. Ford, if you'll come forward. Why don't my colleagues stand and join me.

I have a suitably framed certificate for you.

(Photographs are taken.)

CHAIRMAN MESERVE: Thank you. Welcome. On behalf of the Commission, I would like to welcome all of you to today's meeting with the Advisory Committee on Reactor Safeguards. The Commission met with the ACRS in October of last year and we discussed a range of issues including, as I recall, risk-informed regulation, thermal-hydraulic codes, spent fuel safety and a variety of other subjects. After the meeting, the Commission requested that the ACRS expand this discussion on some of the problems with thermal hydraulic codes and we have received that letter and I know that's an area that we'll be dealing with later today.

Since our last meeting, the Committee has continued its activities in risk-informed regulation and various aspects of license renewal and has considered a number of other issues. One of the most important was a comprehensive review of steam generator performance which will also be discussed this meeting.

So I'd like to, on behalf of the Commission, express our appreciation to you for your efforts and to indicate that we very much welcome our capacity to interact with you today.

Let me say before we get started that I have recently learned that Tom Kress has recently been elected a Fellow of the American Nuclear Society. On behalf of the Commission, I'd like to express our congratulations to him for what I know is a richly deserved honor.

Dr. Apostolakis, you may proceed.

DR. APOSTOLAKIS: Thank you, Mr. Chairman. It's a pleasure for the Committee to be here and have the opportunity once again to discuss our recommendations and conclusions that we sent to you in writing, to discuss them with you.

We have five items with you today to discuss: proposed framework for risk-informed changes to 10 CFR Part 50, the South Texas Project Exemption Request Option 2, thermal-hydraulic codes, status of steam generator issues and status of ACRS activities on license renewal.

I'd like to point out that we have actually sent you letters or reports on four of these items and the fifth one, the South Texas Project Exemption Request we have not written a report, so you will hear some preliminary thoughts and maybe we can blame Mr. Sieber for some of the opinions that will be expressed.

I propose that since we have five issues to discuss we use a uniform distribution and spend 20 minutes on each, unless, of course, you want to change it. We'll spend about 20 minutes on each subject.

CHAIRMAN MESERVE: Ten minutes for the presentation and then we'll --

DR. APOSTOLAKIS: Yes, ten and ten.

CHAIRMAN MESERVE: And then what we'll do is we'll go through the --

MR. McGAFFIGAN: That was not risk informed.

DR. APOSTOLAKIS: It was very risk informed.

Okay, so we start with framework for risk inform changes to 10 CFR Part 50 and Dr. Shack will make the presentation.

[Slide change.]

DR. SHACK: We sent you an ACRS report dated November 20th concerning the proposed Option 3 framework document and there are a number of important elements in that document that I really won't be discussing the whole document this morning. There are two elements I would like to focus on.

One of the important things that the framework provided was guidance for the prioritization of candidate regulations to be risk informed. The second element that I'll probably focus on is the guidance that it provided on the use of defence in depth in a risk-informed regulatory system. This has been a topic that's been of considerable interest to the ACRS.

Reg. Guide 1174 which has provided guidance for much of the application and development of risk-informed regulation states an intent to maintain the defense in depth philosophy and provide some helpful discussion on the role of defense in depth to its relationship to uncertainty.

The framework document provides further development of how defense in depth is used in a risk-informed regulatory system. The important thing for to know is that it includes some elements of defense in depth that are employed independent of risk insights which in ACRS terminology, the Commissioners don't always appreciate the structuralist point of view.

But then it looks at additional assessment of defense in depth elements such as redundancy and diversity and safety margins and emphasizes that they can be qualitatively evaluated in PRAs in terms of safety functions, success probabilities and can be quantitatively assessed in terms of the degree of uncertainty one has on the prediction of safety outcomes.

There's also another important difference I would like to bring up that becomes important here in using Reg. Guide 1174 where you're assessing the change in risk for a particular licensee who brings in a request for a proposal change to his licensing basis. There, you have a rather good handle on the kind of changes and risk that are involved because you're dealing with a license and his plants.

In Option 3, you have to consider the changes and you have to, in a sense, anticipate the changes and risks that may occur in a much broader class of plants, when you're changing an overall regulation that applies to the whole regulatory system.

Now the framework document essentially proposes in risk informing the regulations we maintain defense in depth by maintaining a balance between prevention and mitigation and so they talk about attempts to limit the frequency of initiating events, limit the probability given initiating eventual proceed to core damage and if core damage occurs, you'll have essentially ways to mitigate that release to the public and prevent release to the public.

The framework provides some important, not only requests that you provide that balance, but it provides quantitative guidelines that essentially state the goal of the balance should be as you're trying to formulate the regulations, and these are described in terms of a CDF guideline of 10-4 per reactor year, a conditional large early release frequency of .1 and a conditional probability of large late release of .1, so in a sense there are three risk matrices that are sort of introduced in the framework document.

I would note, for example, 1174 doesn't explicitly mention the late containment failure probability criterion, but that came an important element in discussion of the South Texas Exemption Request where one was trying to use risk information to categorize risk significant components and again, the question was whether one did that strictly on the basis of a CDF and LERF which are really the large early release, but whether you would also have to consider the large late containment failure, which again is described in the framework document.

I looked back over our report from November and discovered that we weren't very explicit in there, but the Committee does support the approach taken in the framework document that the regulatory system should maintain at this high level a balance between prevention and mitigation and that the quantitative guidelines suggested in the framework are reasonable and consistent with the safety goals.

We did have some -- again, I think as one applies this one, we'll gain some experience. We had some comments on some of the definitions of initiating events that were given in the framework document.

We're also concerned that although we believe the structuralist approach is appropriate at the high level that it's introduced into the framework document, we would like to emphasize that defense in depth measures at the lower levels should not be imposed except when they're significant on certainties and one should really try to address the level of defense in depth through the quantification of the uncertainties.

The other important activity in risk-informed regulation that's come before us is the subcommittee meeting that we held to discuss risk informing 10 CFR 50.46 concerning the emergency core cooling system.

As you know, industry is proposing to use leak before break and probabilistic fracture mechanics to define a new large break loss of coolant accident that would be considerably smaller than the double-ended guillotine break that is the current design basis accident for the large break LOCA. And again, the suggestions are that it could be something on the order of a 6 to 8 inch diameter.

I would point out that the NRC has used leak before break arguments before in assessing the dynamic effects of pipe break. It has accepted them for a certain class of systems.

A lot of discussion at the subcommittee meeting, I think both the staff and the industry recognized that there are substantial benefits that could be obtained by redefining the large break LOCA. Most of us agree, for example, it introduces unrealistic start up requirements for emergency diesel generator systems and in fact, these requirements may be counter productive to safety.

However, although the staff has accepted the leak for break arguments in the context of dynamic loads, they made the argument in the context of the change as fundamental as 10 CFR 50.46 that one would need a much more careful assessment of the uncertainties associated with the leak before break argument, especially in light of the recent incidents of stress corrosion cracking in the primary piping system seen at Summer and Ringhals in Sweden. In the original application of leak before break, it was assumed that stress corrosion cracking would not occur in PWR primary piping systems and that the leak before break was not accepted in systems that were susceptible to stress corrosion. Because of the potential that stress corrosion cracking has for leading to large circumferential cracks in some cases that are difficult to detect by leakage before failure.

This is a matter of considerable discussion. Again, I would note one thing that I thought was rather interesting in the industry's proposal, as I mentioned, one of the difficulties in dealing in Option 3 is to assess the impact of all the changes that would be made in terms of a large class of plants and I thought the industry proposal to revise the large break LOCA definition, only to permit the NRC to evaluate an appropriate large break for a plant or a class of plants so in fact, one would not have to deal with all the implications at once, but once one had established a process for defining the large break systems, one could then evaluate the changes in risk on a smaller, more manageable class of plants.

We'll be continuing meeting in our upcoming June meeting, have further discussions on 50.46 and see how that's progressing and we do plan to issue a report on the June meeting. We expect to have an Options paper from the staff describing their views on how to proceed on 50.46 and compare that with the industry proposals at that time.

CHAIRMAN MESERVE: Why don't we proceed and do a few more of these and then go to questions?

DR. APOSTOLAKIS: The next presentation is by Mr. Sieber on South Texas Project Exemption Request.

MR. SIEBER: Good morning. During this presentation, I plan to give you an update on the progress of Option 2 to risk-informed Title X, Part 50 of the Code of Federal Regulations.

Option 2 is exemplified by the application of the South Texas Project, which I will refer to as STP in the future, to be exempted from a number of regulations under Title X ranging from Part 21 which is the definition of a basic component, all the way to Part 100, but the bulk of which are in Part 50.

And these exemptions would apply to components at STP that are not contributors to risk for their licensed facilities.

The request for exemption is important to STP because they believe it could reduce their costs of operation, while not reducing safety, but as in the case of every application of risk information to the operation of the plant, the balance goes both ways. You may be able to eliminate some requirements or you may find risk-significance that were previously not treated by the current regulation in some components where then the special treatment would have to be upgraded. This was the case at STP. They were able to eliminate, recategorize some components as being not risk-significant, but other components that were not currently listed as safety related, were identified because they are risk-significant and therefore, there's two approaches that need to be taken in this instance.

The nuclear industry is watching the progress of the STP exemption requests and hopes that it may be applied to other licensees. And the industry hopes that the STP exemption request will become a template for future licensing actions for the remainder of industry licensees who choose to submit requests for it.

The STP exemption request has been on the docket one way or another for almost two years now, and in fact, this request has a lot of complexity to it.

[Slide change.]

MR. SIEBER: In my next slide we illustrate the fact that parts of 11 regulations are affected, resulting in something on the order of 19 different sections of these 11 regulations that need to be changed or modified to accommodate the exemption request.

That, to me, makes this process a very complex, legal process. The next slide I would like to describe a little bit about the licensees' facilities. My background is in plant operations and maintenance and therefore any time I see a nuclear power plant I like to know a little bit more about it.

The STP plants are twin-unit plants. They are of recent commercial operation. They went into commercial operation in 1988 and there are four loop plants, 1250 megawatts apiece and they have large, dry containments.

Another feature that I would point out which I think is important from a risk standpoint is these units have three safety trains as opposed to the two normally required by the regulations. And therefore, from a risk standpoint this plant has a good posture.

In addition to that, another attribute of the licensee is that they have a comprehensive, up-to-date probabilistic risk assessment for that plant that is basically a state-of-the-art and probably one of the leading PRA documents and results in the industry. So that makes the use of that PRA as a reliable source of risk information.

[Slide change.]

MR. SIEBER: Slide 4, I talk a little bit about the purpose of the exemption request and basically the purpose is to identify components that are important to safety from a risk standpoint and eliminate components not important to safety from special treatment requirements including 10 CFR 50 Appendix B. And then secondly, to identify non-Q and that is a colloquial term which means non-safety-related or not a basic component as defined in Part 21, but they want to identify non-Q components that are risk significant and this is the case where special treatment would be increased.

There are two important processes that go on in the process of implementing risk information to the exemptions that are requested by STP. The first is the categorization of components and secondly, what kind of special treatment will be provided to the various categories of components.

[Slide change.]

MR. SIEBER: In the next slide, I'd like to give you a little perspective, again, from an operating standpoint of what we're talking about in terms of numbers related to components in a nuclear power plant.

A two-unit plant like this one will probably have about 80,000 components that have MARK numbers in it. And they will be in roughly 65 operating systems in the plant. Of the 65 systems, 29 serve some safety function and in those 29 systems, you have about 44,000 components and the number of components that are on the plant's Q-List or are basic components is about 17,000, so we're actually talking about a lot of components here.

Now when you take the PRA and do a PRA analysis of the plant, that -- the PRA considers only those components that potentially would have risk significance and that amounts to about 2400 components in a plant this size. So we now are able to analyze 2400 out of the 80,000 that are basically there.

That amounts to about, in the next slide, about 6 percent of the total components that are

potentially risk significant and so the PRA categorization process is responsible for 6 percent and 94 percent must be done by an expert panel through a methodology.

The outcome of both the operation of the PRA categorization and the expert panel is shown on the next slide, which is Slide 17.

[Slide change.]

MR. SIEBER: And they have developed a two-by-two matrix into which they bin all the components in these 29 systems. And the results of that binning is that 3,810 are about 8 percent of the components that were identified as nuclear safety related are also risk significant. If you look at the two-by-two matrix, across the top, which is Boxes 1 and 2, those are the ones that are either the PRA or the expert panel determined to be risk significant. Boxes 3 and 4 are the components that were determined by unit process to be not risk significant. Boxes 1 and 3 vertically are nuclear safety related. Boxes 2 and 4 are not nuclear safety related.

When you look at this matrix, you can see that Box 1 is not a regulatory concern because they previously were basic components, they're risk significant so special treatment does not change for those. Box 4 is not nuclear safety related and not risk significant, so nothing changes for those components that they can use standard commercial practice. Box 2, on the other hand, is not new classified as nuclear safety related, but those components are risk significant, so special treatment will have to be upgraded to nuclear safety related treatment to the extent practicable. And that amounts to 372 components. And the bigger question then occurs when we discuss Box 3, which by previous regulations or current regulations, they are nuclear safety related components, but their risk significance is minimal. And so the question becomes what kind of treatment in the design, purchase, operation, maintenance and all of the other 18 criterion in appendix B should be applied and to what extent to these components in that process.

And then, of course, the licensee would like to use what they call commercial practice and there is such a thing as commercial practice to apply to these components. My personal opinion is I've worked in nuclear plants for 40 years, including a couple of side trips into coal plants and oil-burning plants and gas plants and commercial practice to me is sort of in the eyes of the beholder. If you look at commercial standards, there are a lot of recommendations and may or should, but not very many thou shall do this or thou shall do that. And so the idea is what benefit do you get out of commercial standards when there is a wide range of application that can be provided.

Now the regulatory expectation for these low risk, but otherwise safety related components is that they remain functional, but perhaps not at the level of quality and reliability that a component would have if it got the full treatment. That means that the license just can't abandon all together or fail to maintain these components because the expectation is that they remain functional.

Therefore, it's the staff's opinion and mine that there has to be some description of what commercial practice really means and the best place to put it is in the FSAR and two approaches can be taken. One is very prescriptive which basically freezes in stone what this licensee and every other licensee could or must do, or another way to do it is to performance-base the expectation and the staff leans to using the performance based method at this point.

[Slide change.]

MR. SIEBER: Now I consider in the next slide three important elements related to risk informing Part 50 under Option 2. The first is you need to have a robust probabilistic risk assessment and South Texas Project certainly has that. To me, that means comprehensive at a Level 3 to be able to answer all the questions that are involved in decision making and also up to date. And so that exists in this case.

The second thing that is the proof of the pudding as far as categorization is concerned is some sensitivity studies. And the sensitivity studies basically take those components that are not risk significant, according to the categorization process and multiply their failure probabilities by a factor of 10.

Now they chose a factor of 10 to simulate the degradation that could possibly occur when they moved from nuclear safety related treatment to commercial practice treatment. And then once they do that, then they reanalyze using the probabilistic risk assessment and compare the results and change in CDF to Reg. Guide 1.174. And if, in fact, this reanalysis of this sensitivity study shows that there is minimal change in risk, then the categorization is reliable.

Now obviously, 94 percent of the components aren't even in the PRA. They aren't modeled that way and so how can you evaluate those? Well, the reason why they aren't in the PRA is that they aren't risk significant because PRA represents all the reasonable success paths to prevention and mitigation of accident scenarios. And so they almost by definition are not risk significant. And therefore, it's possible to categorize them that way without further work.

Lastly, the third important element that I think should be in this process is a documented treatment process. Whether it's proscriptive or performance based, there has to be some measure to provide a reasonable assurance that the components in Box 3 will remain functional.

Now the question is where do we go from here?

[Slide change.]

MR. SIEBER: In my last slide, I can say that this process and the work by the staff and the licensee is nearly completed. The ACRS has not written a letter on it yet because there's some documents that need to be finalized, including the safety evaluation report, final resolution of some open items and the documentation that will be included in the FSAR on commercial treatment. Once that's done which we expect will occur in perhaps July, then the ACRS will write a letter on this whole process and these specific exemption requests.

In my personal opinion right now, I see no show stoppers that the ACRS would report, even though there has been plenty of discussion among us and so there are things to talk about. So that, in conclusion is my presentation on the South Texas Project.

DR. APOSTOLAKIS: Would you like to proceed, Mr. Chairman?

CHAIRMAN MESERVE: Yes.

DR. APOSTOLAKIS: The next presentation is on thermal-hydraulic codes by Dr. Wallis.

DR. WALLIS: As the Chairman mentioned earlier in his introduction, this topic was one of our topics at the last meeting we had. Since then we've written three letters. We've met with three code owners and we've also had extensive discussions with the staff.

The thermal-hydraulic codes have been around for a long time. They have proved very useful for regulatory requirements and in the past they've required that the staff carefully examine each code for each application, use professional judgment and be assured that the positions of the code were sufficiently conservative, that safety was preserved.

With the move toward the use of codes for a more realistic sense and less conservatism that we take the code as predicting what really happens, not some extreme case. There are greater demands on the codes. How the code originates is to show that the codes are good. And this requires, in many cases that the documentation be improved to justify what is in the code and also that a measure of this goodness be provided. Then the rational measure of goodness is how accurately do the predictions represent reality and the measure of this is a measure of uncertainty and therefore, the realistic codes, the evaluation of realistic codes requires that we have definitive criteria for assessing this uncertainty.

One of the things that has happened in the last few months that the ACRS strongly supports is that the NRC staff has obtained and exercised the applicants thermal-hydraulic codes themselves so they don't have to rely on extensive give and take with the applicant. There's less of the -- figure out which question to ask, waiting until it's answered and then going back and ask another question. We see this as being much more efficient process and also adding confidence and that the staff can use the code itself rather than relying on what's supplied by an applicant.

I'd like to point out to the Commission that we have met with Westinghouse on the important issue of AP1000, but we have not yet got to the point of examining the codes and Westinghouse has not yet agreed to supply them to the staff for exercising by the staff.

In one of our letters to you, we addressed the question of the impact of codes on the performance goals. I'll just a little bit about that and in terms of maintaining safety, we pointed out that we don't have a good measure of code uncertainties, then there may be safety questions raised, for instance, if the code is predicting that the core is covered in some accident sequence, but because of uncertainties, there's a probability which is not insignificant, that the core may be covered, then the questions are raised about does this have an impact on safety. So we have to have a good understanding of these uncertainties.

In the area of public confidence, these codes, even if proprietary, eventually are seen by practicing engineers, by researchers in universities and essentially it informs the technical public and when this informed technical public sees what's in these codes, they should get a feeling that the quality is good, that there are not errors or assumptions which they would be led to question.

In the area of efficiency and effectiveness, it's quite clear that if the documentation is poor, the validation is not extensive and the assessment is insufficient, then there's a lot more work for the staff and the applicant to go through before the staff can be assured that the code is good enough. And in the extreme case, there may be a requirement for additional experiments.

Another aspect of this is that if the staff is not comfortable with the code they will tend to impose a lot of restrictions on its use and this imposes additional burden on licensees. Licensees have to do a lot more work to justify why the code should be used for their particular application and this could perhaps be alleviated if the documentation and assessment were better in the first place.

And to continue this discussion of burden, if there are too many uncertainties in the code, then the staff will err on the side of making conservative decisions which will mean that margins have to be bigger and this essentially enforces a further burden on industry.

Some of the things we've been doing, we reviewed Siemens S-RELAP5 code, specifically for Appendix K small-break loss-of-coolant analysis. This is not a best estimate or a realistic code assessment. This is the Appendix K conservative regulation.

And we concluded the code is adequate for this application. This was mostly based on the fact that codes of this type have been used for this application before. The staff is very familiar with them and this code meets the requirements of those regulations.

But at the same time, we looked at the code in the light of its eventual development for realistic applications and as we told in this letter, there are some aspects of the documentation which need to be approved.

We also considered the EPRI RETRAN-3D code, the Thermal-Hydraulic Phenomena Subcommittee had concerns which you're probably familiar with by now, with the momentum equations. Now we raised these in our last meeting with EPRI and EPRI conceded that our concerns had merit and at the moment, we are awaiting EPRI's response.

Meanwhile, the NRC staff has been active. For some time they've been developing what is very much needed in this area, a regulatory guide and a sounder review plan. We have been interacting with the staff along the way and these two documents have been out for public comment. The public comments have been received and a workshop was held last month. The resolution of these public comments, we are told, may take some time and it will probably be at the end of the year or so before these documents actually see the light of day in their final form.

And meanwhile, the Office of Nuclear Regulatory Research has also been developing a consolidated thermal-hydraulic code to put the Agency's codes into one code instead of several. We are pleased with the progress they have made. We strongly support the Agency having its own code to make independent assessments as well as to create expertise within the Agency which gives a competence to review vendor codes.

That's all I have to say. Thank you.

CHAIRMAN MESERVE: Thank you. Why don't we go through them all.

DR. APOSTOLAKIS: Steam generator issues, Dr. Powers.

DR. POWERS: What I'm going to try to do is give you a whirlwind tour and thumbnail sketch of the fascinating world of steam generators.

MR. McGAFFIGAN: Is this at 80,000 feet?

(Laughter.)

DR. POWERS: No, we're going to get quickly back into the sludge of this one.

As the Commission is aware, steam generators constitute a little over 50 percent of the pressure boundary for the reactor coolant system at a pressure water reactor. Should there be a rupture of this portion of the pressure boundary, you can release radioactivity into the environment because it's not backed by the containment.

This is a known vulnerability to the pressurized water reactor design and consequently since the design has been conceived, plants have been required to be able to cope with a steam generators tube rupture itself and with the leakage through steam generators in the event of a rupture in the main steamline break.

What's important to recognize is steam generator tube ruptures are not hypothetical accidents and on your next slide, I've listed the steam generator tube ruptures that have occurred.

[Slide change.]

DR. POWERS: It first took place in 1975. The most recent that I think is familiar to you is the Year 2000 at Indian Point.

This slide has room for at least another entry on it. It's simply a matter of numbers. There's something over one million steam generator tubes in use today and even if the regulations were to provide an unreliability of some like 10-7 you would expect that once in a while there would be a steam generator tube rupture.

You can look at this slide in a couple of ways. It certainly tells you that steam generator tube ruptures occur. It also tells you that the plants cope successfully with these steam generator tube rupture events. If they were not, or if the events of a tube rupture were propagated to overwhelm the coping capacity, you do enter into a severe accident space to a class of accidents the PRA refers to as bypass accidents because the radioactivity bypasses the containment. Those class of accidents have the peculiarity of being risk-dominant at some plants, even though the frequency isn't especially high.

Consequently, as I've indicated on the next slide, the steam generators continue to receive attention both from the industry and the NRC. Industry attention is taking the form of continuing to develop guidelines for the monitoring of the tubes and the on-going process of replacing and monitoring steam generator tubes.

On the next slide I show you what the problem is.

[Slide change.]

DR. POWERS: The problem is one of corrosion and this is a cartoon of a steam generator. Please understand they are good deal more complex than this cartoon. It illustrates what types of corrosion that we have encountered within the tubes. You'll see that there was in the past conventional corrosion which involved the wastage away of material. The industry went through fairly heroic efforts to eliminate that from concern and perhaps a testimony to Mr. Murphy and his laws, promptly a new type of corrosion appeared which is stress corrosion cracking. We observe that cracking certainly in the high stress regions up in the U-bend. We also see it from residual stresses on the free span. The more interesting and novel stress corrosion cracking occurs in the visually inaccessible regions within the tube sheets that support the tubes and the tube support plates themselves.

[Slide change.]

DR. POWERS: Turning to the next slide, the corrosion is prompting the replacement of -- well, in the next slide I want to show you some examples of the stress corrosion cracks to indicate that these cracks are small and they're relatively difficult to detect.

That kind of corrosion is prompting the industry to consider the replacement of steam generators and on the next slide I show you a slide that I just love.

[Slide change.]

DR. POWERS: It's a photograph of the process of changing -- of moving a steam generator and it will remind you what a tremendously heroic job that must be to change out a steam generator tube.

The objection in replacing a steam generator tube, of course, is to replace it with alloys that are less susceptible to the steam generator, to the corrosion processes. In general, the alloy 690 is being used. We are seeing, however, in laboratory experiments that even the 690 allow may be susceptible to stress corrosion cracking although we haven't observed that in situ.

That gives us pause about relieving any of the extensive monitoring processes that are imposed on steam generator tubes.

As I indicated to you, the corrosion processes afflicting steam generator tubes have evolved over the years. When the regulations were originally written, the concern was over the uniform wastage of a tube, especially in visually accessible areas and so regulations were imposed on the amount of thinning of the tube that could take place. Now we have evolved into the point where stress corrosion cracking is the issue. And it's that cracking takes place certainly in visually accessible areas such as the free span. It also occurs inside the tubes. They're not visually accessible and in this tube sheet, tube support plate, they're not visually accessible.

[Slide change.]

DR. POWERS: We have, as I've indicated on the next slide, an adequate technology for crack detection. What we're not so good at is actually sizing the cracks, that is, determining how deep the end of the tubes they go.

Consequently, the staff has had to evolve its approach toward the repair or replacement of defective tubes from using crack size, individually in accessible areas of the tube support plates to one of using the voltage in the detection device.

The ACRS has spent some time this fall going through a rather thorough examination of some of the features of this alternate repair criteria, the staff has come up with and in the course of doing that review, we did identify some areas that I've listed on the next slide of where the technical basis for the alternative repair criteria could be strengthened. These include studies on the forces and the effects on tubes during accidents such as the depressurization on a main steamline break, the data base --

DR. DIAZ: Excuse me, I'm sorry. I believe you're currently on Slide 41?

DR. POWERS: Yes sir. Depressurization of main steamline -- the database that we have for the 7/8th inch tubes relating to crack size and voltage, monitoring of the -- for systematic deviation from the hypothesized bounding crack growth rates and understanding of the iodine release that would be associated with a steam generator tube rupture.

[Slide change.]

DR. POWERS: The real question that you have with steam generator tubes is not the failure of a single tube, but can the tube failures propagate and they will overwhelm the ability of the plant to cope with them. Such propagating failures could be hypothesized.

DR. DIAZ: Excuse me, that's not what your slide says. Your slide says "can degraded tubes fail" --

DR. POWERS: Yes.

DR. DIAZ: And the answer to that is?

DR. POWERS: Tubes certainly can fail and they do. The real question is can you propagate the failures and get multiple tube failures that overwhelm the ability of the plant coping system.

One possibility, of course, is that the forces imposed on a main steamline break that caused this propagation, the staff has recognized that considering this is a potential area for generic research.

The other question is can tubes fail during severe accidents as a result of the heat and pressure loads that are imposed on them. That would have the effect of turning a severe accident into a containment bypass accident. That would occur only if the primary coolant system remained pressurized and I hasten to add that licensees have developed accident management processes that endeavor to depressurize the reactor coolant system and to the extent that those processors are successful they moot this issue.

[Slide change.]

DR. POWERS: Nevertheless, it does appear that we need to have a better understanding of the behavior of degraded steam generator tubes under severe accident conditions. It comes about for a practical purpose. The licensees are requesting relief from some of the requirements for monitoring steam generator systems and they are casting these requests in the language of risk and indeed the staff is reviewing those questions in the language of risk.

Consequently, the staff certainly feels it needs a better understanding of the analytic tools that the licensees are using to formulate their requests and that includes tools like the MAAP code.

[Slide change.]

DR. POWERS: Right now, our approach to monitoring steam generator tubes is an empirical approach. And is there ever going to come a time when we have a really mechanistic understanding of stress corrosion cracking and the prediction of leakage from degraded steam generator tubes that is commensurate with our ability to predict the bursting of degraded tubes.

My answer to this is not any time soon, this entire process of stress corrosion cracking is one where we do not have the kind of comprehensive mechanistic understanding that we have for convention corrosion. It is obviously a much more complicated technical issue.

If we are to get a better understanding of stress corrosion cracking, this certainly is going to require much better data on the cracks themselves. Until we have that, the inspection and empirical prognostication of how tubes behave, will be the prevailing approach for some time to continue.

That's what is my promised thumbnail sketch of the issue.

DR. APOSTOLAKIS: Thank you. And the final presentation is on our activities of license renewal by Dr. Bonaca.

DR. BONACA: Yes, good morning.

[Slide change.]

DR. BONACA: The purpose of my presentation is to update on the status of ACRS activities on license renewal. Recently, we have been quite involved in these activities in two ways. One, reviewing the generic guidance documents that have been developed by the staff and the industry, and second, specifically reviewing two applications in front of us, at this time, the one for Arkansas One and the one for Hatch.

First of all, I'll talk about the license renewal guidance documents. You are familiar with the standard review plan which, of course, is in front of you and Reg. Guide 1.188, Standard Format and Content, and the NEI 95-10 document, 1.188 references and endorses.

And finally, you're familiar with Generic Aging Lessons Learned report. We find that report to be a remarkable compendium of information assembled that is very significant to the industry and to the NRC. It provides really a fundamental baseline and it defines acceptable programs. That compendium of information would be very useful both to applicants because it provides an acceptable baseline and to the NRC.

And because of the volume of these documents, we felt very strongly that the documents should be approved at this time, although there is still some procedural debate going on between the staff and the industry on some issues. The timing is right for approving these documents because we believe their approval will facilitate future applications and reviews.

We do feel that the staff has developed an effective set of guidance documents. These

documents are effective. In our letter to you, we have recommended that although we recognize that the adherence to the rule means that all you have to identify in the application is the way you're going about identifying the components subject to the rule, the end results of the process, the inclusion, for example, of the results of the scoping portion of the study facilitates the review to the point that we encourage all the licensees to include that information.

One of our concerns has been scrutability of the documents to interested members of the documents. The documents should be clear. This is not a very obtuse technology. This is just a painstaking effort to identify the components, screen them to put them on a list and then to identify the aging mechanism, then the programs as they go forth there should be clarity in this process and the documents can do that.

Now I want to point out, for example, that Arkansas One has provided us with an application that is, in fact, one of the smallest in volume and yet is very clear. You can really walk through it and understand what it is. And so, in fact, proper information doesn't mean that you have to have necessarily a burden. You can really work very effectively as long as you have a clear process through the documentation.

[Slide change.]

DR. BONACA: I'm now referring to Slide 48. We have recommended, as you know, and the staff has agreed to update the GALL Report periodically. There is still information we are getting from new applications. For example, just a review of Arkansas we have right now brings significant insight on inaccessible cables as well as susceptibility of small-bore piping and this kind of information needs to be put back into GALL as the opportunity comes. So frequent updates or periodic updates of GALL will give an opportunity to improve the database and the baseline of the recent license renewal. With the updates of GALL, this should also be updates of SRP and Regulatory Guide 1.188.

[Slide change.]

DR. BONACA: The Subcommittee on Plant License Renewal reviewed the application of Arkansas One on February 22, 2001. This is an interesting application, as I mentioned before, because the work documentation is not voluminous. But the lessons learned from previous applications were clearly realized in this application.

The standard format was pursued consistent with the guidance of NEI and the staff. As a result of this, there were fewer RAIs, requests for additional information, and only six open items to the point where the Subcommittee on License Renewal recommended to the Committee that we would not have an interim letter because there was nothing to comment on, that we could add to the review. So this is an example of a successful way of an applicant to expedite the process.

[Slide change.]

DR. BONACA: The result of that, and I'm jumping a slide here, I guess, to -- well, the result of that is we have reviewed the Arkansas application during this meeting, in fact, and with five months ahead of schedule. It was possible for us to support that kind of timing and schedule.

[Slide change.]

DR. BONACA: With reference to Slide 50, we reviewed the Hatch license renewal application SER with open items on April 13, 2001. And with that also we reviewed the Boiling Water Reactor Vessel and Internals Project Topical Reports. We didn't review them all. That's not the purpose, but we reviewed four of them and we find to be this project as defined in excess of 20 topical reports a significant investment that provides very sound baseline for supporting accident management, aging management programs for boiling water reactors.

We support the perspective of the staff that these generic documents did indeed support the application of BWRs.

[Slide change.]

DR. BONACA: We found the staff review of the Hatch license renewal application was extensive and thorough. We found the processes implemented by the applicant adequate, although there are still open issues to be resolved and we agreed with the staff with most of them although some of them are open and there is an appeal process going on. We chose not to interfere with the appeal process until a decision is made.

And finally again the BWR guidelines effectively support license renewal.

[Slide change.]

DR. BONACA: As I mentioned before here on Slide 52 we supported a staff request for an ACRS review of the Arkansas application and I just say that we could do that because of the characteristics of the application I described to you before that facilitated the review. And there was already on the basis of the application, there was a baseline already that we had seen before in previous applications that facilitated the whole process.

[Slide change.]

DR. BONACA: We are planning to review our first Westinghouse design, BWR, Turkey Point, October 2001 and we plan to complete a review of the Hatch application in November 2001.

We plan to discuss among ourselves, if in fact, there are needs to revise the rule and we will have the discussion in June and plan to provide you with any comments that may result in discussion in July.

[Slide change.]

DR. BONACA: As we announced before we will form two subcommittees next year to handle the volume of applications that will come our way.

That completes my presentation.

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

CHAIRMAN MESERVE: Good, I'd like to thank you all for a very helpful presentation.

I have a few questions.

Dr. Shack, on Slide 7, one of your comments that you wanted to clarify, the defense in depth measures should not be imposed at -- lower tiers is the word that it uses in the slide, lower levels is the word you used in your presentation. As I read the framework document, they're talking about using the structuralist approach at a very high level, at accident prevention you have 10-4 core damage frequency and accident mitigation at 0.1 frequency. That could be what you mean at a high level?

DR. SHACK: Yes.

CHAIRMAN MESERVE: It could also be that you're talking about systems rather than components? What do you mean by -- what guidance are you giving us when you use the reference to lower tiers?

DR. SHACK: Everything below that top level that we've identified as the structuralist point of view. From there on down, you should be assessing the need for defense in depth.

CHAIRMAN MESERVE: So it would be rationalist approach below that?

DR. SHACK: Below that.

CHAIRMAN MESERVE: And you fold in uncertainty in your analysis for the redundancy.

DR. SHACK: And again, I think the framework does have that. We were looking for a slightly stronger commitment to that.

One of the important things I think they did in there was to identify, for example, the contributions of the safety margins and the ways that you quantify those is an element of defense in depth. So the framework, I think, was on the mark. Our letter was just looking for a somewhat stronger commitment.

CHAIRMAN MESERVE: Okay, Mr. Sieber, on your Slide 17, you made the point that categorization process has to rely on an expert panel for -- you have the over 94 percent of components because this small number of them are covered by the PRA.

MR. SIEBER: That's correct.

CHAIRMAN MESERVE: Are you satisfied that the process of categorization is sufficiently

scrutable, that people can have confidence that the categorization decisions are ones that are ones that deserve credence or are appropriate?

MR. SIEBER: Yes, I am and for a couple of reasons. First of all, the expert panel uses a rigorous process of asking a series of five questions which relate to how each component functions with regard to its safety role and there are several methods of weighting and scoring these as an initial screening process.

Some of these questions might be would the failure of this component create an initiating event in the PRA. Another question would be does it appear in the emergency operating procedures or their emergency response guidelines. That could be, for example, a pressure instrument or a control or at the other end of the control the operator or valve or pump or motor. So for that reason I think that the methodology that the Panel uses was rigorous.

The second reason that I think is important is, as I stated before, the PRA actually models all of the success past, regarding the prevention or mitigation of events or accidents. And because the process is structured that way, those components that are -- how shall I say it, not worth modeling because their risk significance is so low, can truly be stated to be of low safety significance. And I feel comfortable about the categorization process, both by the PRA process and the expert panel.

Now an interesting thing that they did is they took the components that were evaluated using PRA and gave those components to the expert panel to rate the same components and to care the results of that and the results of the expert panel were virtually the same as the results obtained through the PRA processing procedure. And in fact, the expert panel was slightly more conservative. They found and declared more elements, components to be risk significant than the PRA had indicated.

And so with those kinds of tests and the process that they used, I feel comfortable that they have done a good job on categorization.

DR. APOSTOLAKIS: I would like to repeat that we have not written a letter on this subject and I am not necessarily disagreeing with my colleague.

MR. McGAFFIGAN: He's not necessarily agreeing either.

DR. APOSTOLAKIS: But I'm not necessarily agreeing either. The words in the final letter may be a little different, but at this point, let's leave it at that.

CHAIRMAN MESERVE: Your Slide 18 indicates that they're about, oh, I guess, 4200 components that are determined to be risk significant?

MR. SIEBER: That's right.

CHAIRMAN MESERVE: In your presentation and actually in your response there you said well most of the risk significant components are in the PRA. And there are only 2400, you said, are in the PRA --

MR. SIEBER: Some were determined solely by expert panel, as far as risk significance.

CHAIRMAN MESERVE: I appreciate that, but it's almost a factor of two that are coming in from the expert panels.

MR. SIEBER: That's correct.

CHAIRMAN MESERVE: I guess the question is that is there something we're missing in the PRAs that there are so many components that aren't captured by it that end up being risk significant? How do you explain -- I'm reflecting perhaps my ignorance of PRAs. I would have thought if they were significant, by definition they are ones that should have been captured in the analysis.

MR. SIEBER: That's correct. I think the criteria between PRA and its use of CDF and LERF as basically the success criteria and the expert panel were different. For example, if a component, perhaps a pressure instrument or a flow instrument were important because an operating relied upon that instrument as part of the procedure for recovering from or mitigating some accident situation and that was a significant instrument that the operator would use, the expert panel would rate that high and call it that, but it may not have achieved the same rating through the PRA process.

And so the combination of the two makes this whole process a little more comprehensive than just using PRA by itself.

CHAIRMAN MESERVE: Mr. Wallis, I think you know we're confronted with the possibility we may see some new designs in new kinds of plants and I wonder if you could comment on or speculate perhaps on the adequacy of the codes for dealing with things like a pebble-bed module reactor or an IRIS integral pressurized water reactor. Are we going to -- are we in significantly new and uncertain territory in dealing with some hydraulic issues associated with advanced designs?

DR. WALLIS: I think the phenomena are the same. I don't think there are new phenomena. The range may be extended and that's where there may be a problem with the water type reactors. If there is a proposal to work it if the pressure is not seen before, but I don't think we anticipate new phenomena, so the code essentially has the ingredients to do the job by water reactors. I think there's more concern with designs which are not water reactors from something else, which is not modeled in these codes. It requires a different code.

CHAIRMAN MESERVE: Sure. Are there codes that are of sufficient robustness that you could use with a helium as the working fluid? Where are we in terms of --

DR. WALLIS: It should be simpler to model helium cooled than two-phase thermal-hydraulics. That's one of the attractions of those designs, frankly. You should be on firmer group.

CHAIRMAN MESERVE: But do the codes exist or do we have to have codes that are going to be validated for that purpose. I understand they should be simpler.

DR. WALLIS: I don't know. I think there are codes there, but there are codes which are specifically designed for nuclear purposes. There are codes which can do this sort of thing, they're out there. Commercial codes can do this sort of thing.

CHAIRMAN MESERVE: Is this a long lead time item for us to have, if we were to have such an application in front of us?

DR. WALLIS: When we're talking about nuclear safety --

CHAIRMAN MESERVE: It's a long lead time by definition.

DR. WALLIS: There tend to be long lead times for reasons which has to do with the way the person has worked. In principle, there shouldn't be. It's not complicated.

CHAIRMAN MESERVE: On your Slide 28, you made reference to a series of the staff documents indicated they were subject to comment, but you did not provide any indication of the general sense of the ACRS on these documents.

DR. WALLIS: We have been over the documents with the staff and we are pleased with the way they evolved.

I think what's happened in their comments that industry has said they're a bit too severe if they're applied across the board and I think we will across that there are certain issues which are not so important and therefore one doesn't have to require everything, that there are certain cases where one can say yes, we're not going to require as thorough an evaluation because this is a less significant thing or we know that we're well bounded by some conservative technology or some limiting knowledge or limiting process.

The thrust of the comments was to qualify these requirements so that they're appropriate to the purpose and to the importance which is, I think we would tend to agree with.

CHAIRMAN MESERVE: Dr. Powers, there have been concerns expressed by a former NRC employee about the Agency's approach to steam generator integrity issues. I recently sent a memorandum to the ACRS to request the reviews on one such important issue, namely whether there are serious issues related to steam generator integrity that require immediate actions beyond those now being undertaken by the Agency. Although the Commission, I'm sure, would appreciate and would expect a written response, this meetings provides me an opportunity to get your preliminary views.

DR. POWERS: Well, the concerns you spoke of, particularly expressed by former staff member which addressed a couple of things, addressed an issue on the voltage limit for a particular plant. That's

an area we haven't touched upon. Also expressed concerns about the response of our examination of the alternate criteria for the repair or replacement of steam generator tubes that we had provided to the Executive Director of Operations.

My view is that the Executive Director has responded appropriately and consistently with our expectations, that we see technical -- the need to technically strengthen that alternate repair criteria via a research program that is carefully considered, carefully executed consistent with the kind of in-depth thought the alternate repair criteria obviously received in its development.

Had we identified anything that we thought was particularly urgent to do about steam generators, I think the Committee would have been obligated to say so explicitly and I think we did not.

CHAIRMAN MESERVE: Thank you. As I think you know, EDO is developing an action plan to respond to the various longer lead items and that's not available yet, but I understand that that is something that's being pushed forward.

DR. POWERS: It's in the offing as I understand and I think we're anxious to see some elaboration on what the plans are.

CHAIRMAN MESERVE: Thank you. Commissioner Diaz?

DR. DIAZ: Thank you, Mr. Chairman. My first comment is of course is it's something that we're all going to understand, but because I think we need to be accountable to the public. Sometimes I think we get into these issues of semantics. So let me just start at a level here that I think we should always be conscious of.

There are questions and answers in practically everything and the questions could be purely scientific or purely technical or the questions could be scientific and technical and have specific value to the regulatory arena which is the ones we're interested in and the ones we always want the Committee to narrow them down. It is important because we all could extrapolate any type of issue to its noncompletion very, very easy.

Having said that I got a particular problem with the issue of uncertainty. I might look forward to some time in the fall to sit down with some of you on the issue of uncertainty because it really bothers me, but let me make a statement for our stakeholders.

If any measurement or any calculation would come down with a zero uncertainty, it would be unacceptable.

Is that correct? Do we have unanimity on that on the ACRS? Madam Secretary, would you like to record that?

(Laughter.)

CHAIRMAN MESERVE: You may want to write a letter.

DR. APOSTOLAKIS: I don't understand the statement.

DR. DIAZ: It's very simple. Since there is nothing like zero uncertainty in any measurement of zero uncertainty in any calculation, the calculation itself is based on a series of assumptions and zero is not there, it could be very small. But since all the calculations are based on our present state of knowledge --

DR. APOSTOLAKIS: I'll go along with that.

DR. DIAZ: Very good. Thank you, sir.

MR. McGAFFIGAN: What is the probability that Dr. Diaz exists?

(Laughter.)

You get into philosophy classes here.

DR. DIAZ: And the point is that we all want to reduce uncertainties that have value to the safety issues, but how much a reduction is needs to be put in regulatory terms and not in scientific terms. It is very easy to question uncertainties in purely scientific terms because we would all like to reduce them.

Now that Dr. Apostolakis has challenged, maybe I'll go back at him.

DR. APOSTOLAKIS: I didn't challenge. I just want to understand.

DR. DIAZ: Good. For example, some people, I sometime made a joke that no two PRAs give the same result. If two PRAs were giving exactly the same result, they would be frauds. They cannot give the same exact result unless they actually put exactly the same assumptions, the same body, the same things.

So the issue of uncertainty is a major issue that needs to be reduced to what is valuable to the safety issue at hand, not only put it in terms of scientific concern. I think it's very important because when we talk about uncertainty, people might take the idea that we don't know and I think we know enough to make judgments on the safety of issues and even the uncertainty is not zero or might not be as low as we wanted, we still are capable of making those judgments and that's the point that I wanted to make.

All right, now having said that, let me go to Dr. Shack in risk informing and Part 50 and of course, uncertainties came out of there. But I have a particular concern that it almost comes out every time on the issue of risk inform in Part 50 or risk information and that is the perception of many of our colleagues abroad and inside, sometimes even inside the NRC is that risk information is a probabilistic methodology and the Commission is very clear that this is a very balanced approach, that includes deterministic, probabilistic and experiential. It's a combination of these things. And what we're doing is we're trying to get conservatively the best use of these three factors to allow us to make proper decision makings.

Sometimes it doesn't come across and sometimes I think in the ACRS presentations it doesn't come across. It comes across as over valuing the PRA because that's a drive that gives us quantitative information. But from the standpoint of how it is perceived by informed people, I mean regulators outside of this country, I think it's important that we in our documents provided a balance that clearly says that we are taking as our famous white paper said risk inform approaches, this is a balance technique and it needs to be valuable. The issue of probabilistic versus defense in depth is a kind of a tug of war that you describe. The more we know about something, the more we know is risk, the less maybe defense in depth we're going to need about it. So it is not a defined process, but it is a wholesome process and I think that needs to be emphasized and I sometimes get concerned that in the effort to maybe simplify it and put the value on it, we do not get this balance expressed in terms that other people, including people inside the NRC realize that there is a balance with these techniques.

Would you like to comment on that, Dr. Shack?

DR. SHACK: I fully agree. I do not believe that we are ready and I'm not -- I'm sort of a conservative person as to whether we're ready for a risk-based regulatory system. I'm a firm believer in a risk-informed regulatory system that uses many of the deterministic arguments to balance what we do now have as uncertainties in the probabilistic system, so I think there is a strong difference between a risk based decision and a risk-informed decision.

DR. DIAZ: Would you say that it is important for the ACRS when they are dealing with risk-informed approach to clearly express that this technique includes all of these components, right up front and use, you know, the PRA as the technique that is coming to support, aid, clarify and quantify the issues that they can better do that within reasonable uncertainties?

DR. SHACK: Yes. I think we tried to do that. Perhaps that emphasis doesn't always come across, but I believe we tried to keep that.

DR. DIAZ: Thank you, sir. Let's see, Mr. Sieber, on the issue of the STP exemption request, I guess we, you know, it seems to be and I haven't really seen an issue with categorization, the issue always becomes the issue of treatment. The categorization, with some minor things, I think everybody agrees that we can converge if we have not already converged on the process of categorization, so it comes down to the treatment and of course, there are two ways of doing with this. It's tell me all the details of the treatment methodology or go ahead and you develop the details and we deal with the problematic aspects, and of course, it goes down to commercial components.

I was a little bit concerned about your characterization of commercial components as being

kind of loose and I agreed that I've been in fossil plants and I've been in many type -- I've been in airplanes. Sometimes I one time tried to get in a rocket, but did not succeed.

(Laughter.)

MR. McGAFFIGAN: If you have $20 million.

DR. DIAZ: The issue is that as you very well know, the distributions for failures that come from the standard plans are really not applicable to nuclear power plants because we do have, even in our commercial components the higher grade of scrutiny and of course I believe that in present day with the civility, the need for power, the emphasis on consolidation and deregulation and competitiveness, I am for believing that these are going to make these people do things better, rather than the other way. I'm convinced that these plans are getting better because there is competition. They know that if they do something that is wrong, they're going to be shut down and that will make them not competitive.

And so having that, commercial grade components that have some specified functionality requirements through programmatic means, do you think that would suffice given the fact that they can actually be conceived to be in nuclear power plants. We think all of the other aspects of QA that might not be Q-grade, but they're already there?

MR. SIEBER: I guess the best way for me to address that is there was a study that the NRC contracted for that was done by Idaho National Engineering and Environmental Laboratory which is a good study that looked in pretty good depth at what the commercial practice really consisted of. And if you read that, even though they show that the distinction that I discussed a little bit about the commercial codes as not being quite as rigorous, the essential elements, if they're followed, are there. As I mentioned, I talked about having worked in a number of plants. If you take a plant that's economically distressed and you choose and you're faced with choosing which of ten components am I going to repair, all the safety related ones or the ones that are downgraded and you end up with an automatic priority list that says I'm going to do all the safety related ones first and then the ones that I don't have a firm commitment or requirement to do, I'll do them as I can. And I agree with you that under today's industry situation with the demand for power very high, that utilities and plant operators are putting extensive effort into making sure that all of these factors function. Now I talked about documented treatment process, but I do think that we are better off allowing the licensees to develop their concept of what commercial practice is and what regulations or commitments we impose upon them should be described in terms of performance measures that lead them and us to match the regulatory expectation of functionality. And I think that if you take that flexibility away from licensees, you inhibit their ability to develop the optimum method that maintains that functionality. So I would be more inclined to go to a performance based specification of treatment than a deterministic based expression.

DR. DIAZ: Thank you, sir. Dr. Wallis, you said something regarding uncertainty that I kind of like, sir, and I want to congratulate that on saying that we need to understand the uncertainty. That doesn't mean that at any one time we're capable of reducing the uncertainty to a value that is made, but understanding the uncertainty is really very, very important. So I thank you for those comments.

I looked at your documents and looked at some of the background regarding the codes and it seems to me that the bottom line of what you know you are really asking is for better documentation. You're not really questioning the validity of the codes to perform in an adequate fashion within reasonable assurance of a protection of public health and safety. You have not found major things, you have found I think wonderful corrections that make the codes better, but you are insisting on and I think it's a good thing on better documentation and there are errors that are factual that those need to be corrected. Is that correct, sir?

DR. WALLIS: Well, we have found errors which should be correct. I would go back to your earlier statement about uncertainty. I think we wrote you a letter in which we said that quality is determined by the degree of uncertainty. The quality of the code is determined by the degree of uncertainty and prediction within the context of the regulatory use of the code and for certain regulatory uses, certain regulators are more tolerant of uncertainty or tolerate of bigger uncertainties and the concern we have is that as margins are reduced, the decisions may be tolerant of less uncertainty, so that in a sense the codes that were adequate in the past may have trouble reaching the degree of uncertainty which may be needed to support certain decisions. It provides uncertainties are reduced, getting closer to some limit. You have to be more certain about the possibility of going over that limit, the accuracy -- the requirements are more stringent. So whether or not -- the codes have been okay in the past. I think we can be very sure there, but we can't make -- reassure you that they'll always be so because the regulatory requirements are evolving and if we reduce the burden and get closer -- wish to reduce the margins, then the quality may have to be improved to something which looked like a tolerable error or an assumption which led to uncertainty in the past may not be so tolerable in the future. Is that adequate answer?

DR. DIAZ: Are we converging to an acceptable level? You think the efforts that have been made?

DR. WALLIS: I think the staff is doing a very good job of realizing that this is true, that the qualities of the code have to match the regulatory decisions to be made and I think we're converging in the sense that the documentation being prepared by the staff to ensure adequate quality is converging on what we think is a good quality document.

DR. DIAZ: All right.

DR. WALLIS: Whether or not industry will always rise to the challenge I think has to be assessed by what they subject.

DR. DIAZ: Dr. Powers, on your steam generator, I guess when you said risk dominant, you are really referring to the essential bypass of the containment. Is that what --

DR. POWERS: That's what gets you into risk dominance, you have less risk mitigation along the flow pathway. With NUREG 1150, they showed that to us.

I will comment that some of that dominance may come because the way we calculate the mitigation along the alternate flow paths is not as well developed as it probably ought to be. So we may over emphasize the importance of bypass accidents, but even without a detailed code calculation you know that if you're venting without benefit of the containment you are probably incurring more risk than you would otherwise.

DR. DIAZ: Sure, but you know, going back to the definition of risk-informed regulation where we have deterministic, probabilistic and experiential components to it and looking at your figure, the table on page 31, and you made a comment that these plants were able to cope with it, I asked that question of the staff, the fact that I have asked the question three times, just to make sure that the answer is correct. You probably know the answer, but I think for the record, I'd like for you to know that in these 11 incidents, the NRC or the licensee, they have not been able to measure -- they have not been able to measure any off-site releases. Only on-site. Only inside of the protected area of the plant area.

DR. POWERS: These are mitigated design basis accidents and quite frankly, one would expect releases certainly below the Part 100 limit.

DR. DIAZ: They were not measured of the site.

DR. POWERS: Nonmeasurable.

DR. DIAZ: Of the site. So the plants were able to cope --

DR. POWERS: Quite well with the accidents.

DR. DIAZ: So the concern is for accidents that are much larger than this whose frequency will be lower than the ones that we're considering in here?

DR. POWERS: I think ipso facto because of the database that you have there. Those are all single to accidents. We have not seen instances of multi-tube accidents.

The question, of course, that's raised is that if you are allowing tubes that have some level of degradation to continue to operate, are you more likely to have a multi-tube accident or not?

That's the question that's being posed. And of course, the staff is imposing requirements on the industry to keep that increase in risk below an acceptable level and where I'm using the term risk in the more qualitative sense, not the PRA calculated sense. And as I indicated to you, the real concern you have is the propagating accident and whether we're getting more likely to have those or not.

DR. DIAZ: And do you see that the NRC is in a path where we should be able to provide a reasonable answer to the issue of the potential for propagating failure and how can the plant cope with it because things can happen. The issue is can we cope with it to minimize a release that will impact on public health?

DR. POWERS: Let me answer several questions here. Let me say that I don't think you want to ask for the staff to be able to do a calculation of some sort to go from soup to nuts on this. This is a very difficult area. Had they done things to try to keep this risk of a propagating accident down to manageable levels, what we would call a reasonable level of risk, here? Absolutely. That's the whole point of their alternate repair criteria. It's been very well considered and conservatively done because there are limiting calculational tools that you have to apply in this area. It's empirical in its nature and conservatively interpreted and maybe as an anecdote to give you some feeling for the level of conservatism that I think that if you look at voltage signals indicative of flaws in tubes and compare that with the leakage that might occur you would say gee, I very well might accept as high as 20 volts here would be a reasonable amount.

The staff has said yes, that might be true, but we also know you have some limited capability to detect these. You may miss some. You may mis-size them. The correlation between voltage and size is not precise and so they impose powerable detection kinds of limits and they impose detectability limits. They set that voltage limit at 2 volts. So they've imposed a conservatism to keep things low, as long as our information base is as restrictive as it is. I think they've done that.

The other thing to recognize is the staff has done more quantitative analysis to say well, how many tubes can rupture and we can handle it. Is it one? And if it happens to go two, is the ball game over there? No. It's quite clear that the existing processes are quite capable of handling three or four ruptured tubes, perhaps as many as 12. Beyond that, the leak rate depletes water supply so you don't have coping capability there.

DR. DIAZ: I understand. Thank you, sir. And very quickly, Dr. Bonaca, on the issue of license renewal, do you see from your perspective any additional improvements that could be made to the process to that we can be really on a path to say this is an acceptable process? Is there anything that has been shown to you as a weakness or a strength that we should actually utilize?

DR. BONACA: I think that the experience is getting significant enough for individuals for type of plants that if the licensees can endorse pretty well the initiatives proposed by the previous applicants so on and so forth, the process can be -- again, the baseline for acceptance already exists. Examples of acceptable processes already exist. I still believe that each of one of the applications will have to be a plant-specific one just because the plants are different, even when they're system plants and they have significant balance of plant characteristics which differ, so there will have to be a need for application.

But I believe that the Arkansas example is a good one where we came down to close to a year plus of time for reviewing the application and that's significantly shorter than the one we have experienced just a year and a half ago.

DR. DIAZ: Thank you, sir. Thank you, Mr. Chairman.

CHAIRMAN MESERVE: Commissioner McGaffigan?

MR. McGAFFIGAN: I'll start with Dr. Shack. I may still be a structuralist at levels below where you evolved and I think that Commissioner Diaz may have been saying the same thing, below this very, very high level of where you would like us to be structuralists and from there below rationalists.

But for me, it's partly the quality of PRA that we've talked about. Do you really believe that
-- I guess you do, but I might as well get you on the record, you really believe that PRAs out there today are such that we can afford to be structuralists, rationalists at all levels below this very high level?

DR. APOSTOLAKIS: I appreciate that, Dr. Shack. No, I don't believe that anyone who really has done any PRA will claim that there are areas where we feel that the models perhaps are not as good as they should be or are not as good as other parts of the PRA, so there -- people are talking about unquantified uncertainties which sometimes makes other people unhappy, but I really think that the people have uncertainties in their mind that they have not quantified. They don't feel that PRAs can help them quantify those, so they resort to traditional measures so I think that is inevitable.

MR. McGAFFIGAN: It may be semantic. You may be showing us a path for the long range future and I'm stuck in the current mud, but I continue to be -- I'm not an unrepentant structuralist at all levels, but I probably am a structuralist a little bit below where you guys are. And you may be too.

DR. APOSTOLAKIS: Let me phrase it in a slightly different way, if I may. If one proposes an additional defense in depth measure of some lower level, I think it would be wise before we accept it to try to do a risk evaluation.

MR. McGAFFIGAN: If you can, right. Let me turn now to Dr. Wallis. I've read your letters and the staff's responses and part of my question is how are you reacting to the staff responses you got on the 15th of April? One of them is with regard to the RETRAN-3D letter that you had sent and the staff basically says they have considered the recommendation that the sensitivity test be run, but they believe the limitations placed on the use of the codes which, I guess, you're just talking to Dr. Diaz about, as described in the SER and the need for future uses to justify the code application will compensate for any potential inaccuracies and the individual coefficients, so therefore we do not believe that further sensitivity studies of the code are itself or its structure are necessary.

Do you agree with the staff on that or is that a place --

DR. WALLIS: I think we're going to accept that. It's a bit unfortunate because it means now that the -- because of the restrictions, the licensees have more burden to justify using these codes and it means essentially that some of these issues will be revisited.

MR. McGAFFIGAN: That's my reaction.

DR. WALLIS: If it's coming back again, we don't need to decide now.

MR. McGAFFIGAN: But you are predicting as I would they will be back because --

DR. WALLIS: Well, if they want to use them they have to --

MR. McGAFFIGAN: Okay. This may get to this issue of structural versus rationalist, but in the other letter they sent you on April 12th towards the back of it they talk about the Reg. Guide 1.174, you would recommend that they consider measures of code quality such as bias and uncertainty, the staff should investigate and recommend how uncertainties and code predictions can be best quantified, etcetera and they're basically begging off again here and they fall back to Reg. Guide 1.174 where they say it discusses in some detail the comparison of PRA results with acceptance guidelines and treatment of uncertainty. Reg. Guide 1.174 recognizes that many sources of uncertainty are not readily quantifiable and the focus is on identifying sources of uncertainty that are. If the NRC were to pursue a risk-based regulatory approach, treatment of uncertainty would be essential, but there's a lot of flog there, but basically, they are saying not right now.

Are you predicting again that at some point in the future they're going to -- if these codes are going to be real, used for things like 50.46 analyses that this will all be back before us and they'll have to do this sort of --

DR. WALLIS: The question of how to respond to this letter is before this Committee right now and we haven't decided.

I think we may respond to some of those points.

MR. McGAFFIGAN: Okay.

DR. WALLIS: Regarding that one I think also they refer to CSAU, I think will give us a

little bit of reassurance there as it isn't all qualitative. CSAU is a pretty strict procedure which requires a quantitative evaluation of uncertainty.

MR. McGAFFIGAN: Okay.

DR. WALLIS: I think also since we're going to have a go at this Reg. Guide again when it finally appears, that's where we will probably try to resolve this issue.

MR. McGAFFIGAN: There's one issue that you mention in your slides and you mentioned it in a letter here and the staff, this notion that people should submit their codes when they want us to approve them. And the staff points out the current regulations do not require working versions be submitted. It's sort of hortatory process to which you all are adding your collective voice. But should we consider a rule change? Would it pass backfit for us to say that we would like to have as a matter of not requesting and begging, but it just is part of our process that these codes will be submitted to the staff so that they can get used to them?

DR. WALLIS: Well, maybe to consider. I think it's too big a question to give you a right answer to.

Certainly, from the point of view of this Committee, the fact that the staff has the code and can exercise it makes the review process very much easier.

MR. McGAFFIGAN: Right. That might be a -- if somebody wants to do backfit analysis on this conversation, I suppose it may take you 14 years to read something that isn't it and two months if it is. That could be a de facto rule change, I suppose, so it probably shouldn't get there. Lawyers will counsel me, but I hope they're listening, whatever.

There's another rule change, I'll switch over to Mr. Bonaca, that you're essentially recommending in another letter in the license renewal space, the staff and that's this issue of again we're encouraging applicants to include the results of their scoping process and their applications, just like we're encouraging them to submit codes. Should we do a rule change? In sort of two slides you mention the encouragement, and then a little bit later you say you're going to give us your views as to need to revise the license renewal rule. Is this a likely coming attraction that you're going to stick by your guns?

DR. BONACA: I don't know. I have not polled, but I think the Committee, in general, agrees on the necessity of having what we call a scrutable application, something we can understand and trace through. That may be part of recommendation on improvement.

MR. McGAFFIGAN: Okay. It's sort of implicit. You mention it on one page, but then the staff says it needs a rule change and so if you're going to stick by your guns you probably have to recommend a rule change and then there's always this famous backfit rule that we have to deal with.

DR. BONACA: Even if we didn't have a rule change, I mean it seems to me that maybe the industry wanted to establish somewhere the minimum requirements and I understand that that may be re-established. But I think we all want to strive for a process that is clear and supports the interested members of the public to be able to look at them and understand what's in scope and what is not in scope.

I don't think it's a hard spot or should be a hard spot on the part of an applicant. They do go through all these components. They develop a list.

MR. McGAFFIGAN: Right.

DR. BONACA: And there's nothing to hide.

MR. McGAFFIGAN: I think it's a fairly powerful argument you made in your letter and I look forward to seeing what you say in July as well.

Dr. Apostolakis, you've had a relatively modest role here today, other than when asked to help on structuralist versus rationalist and all that. But it's not necessarily on the agenda, but I wanted to give you a chance to talk a little bit about risk-based performance indicators. You said some things back in April that were reported in Inside NRC and Nuclear News Flashes about the staff putting costs before benefit or -- I don't have the thing right in front of me here. I'll tell you, my reaction on risk-based performance indicators is that they're still a ways off and that the comments that the staff made or the NRR staff, Bill Dean made to Tom King back in December were quite appropriate given the state of play. I continue to think they're sort of a gleam in somebody's eye and they'll be very hard to pass a backfit test, the risk-based performance indicators. So I just want to get a sense whether you want to clarify any of these comments you made back in that April meeting or have a little bit of a dialogue with you about it?

DR. APOSTOLAKIS: Well, first of all, as it turns out, I was not supposed to have seen that document. That was already a mistake there.

MR. McGAFFIGAN: You were not supposed to have seen it?

DR. APOSTOLAKIS: The memorandum, no. But I wasn't aware of that. I had seen it.

MR. McGAFFIGAN: Okay.

DR. APOSTOLAKIS: And the general sense I got from reading it was that it was cool towards introducing risk-based --

MR. McGAFFIGAN: I think that's a totally fair comment to say that that document was cool towards introducing risk-based -- but the question is the motivation for why it's cool.

DR. APOSTOLAKIS: I don't believe that an argument that says the licensees will react negatively because this will introduce additional burden. That argument by itself is not valid for me. And I will go back to what Commissioner Diaz said. This is an integrated decision making process. If there is a need to introduce a performance indicator because we're not monitoring something, let it be. If we are duplicating something, then we should know about it.

MR. McGAFFIGAN: We have to understand the benefits of these indicators.

DR. APOSTOLAKIS: Exactly.

MR. McGAFFIGAN: And I think the staff was also going in its questioning at whether some of these indicators would really have benefits attached to them. It wasn't just cost. It was substantial arguments as to whether benefits were --

DR. APOSTOLAKIS: I believe what's missing from all this approach which would have prevented some of these problems is a clear approach to establishing a balance between the baseline inspections and the performance indicators. And I don't think we have that yet.

When someone introduces the possibility of a new performance indicator, I think in the same document there should be an argument that either we are not covered in this area, or we're replacing another indicator or we will introduce this because it's a more objective indicator and we will reduce the baseline inspections appropriately.

As long as we don't -- for example, if I were a licensee myself and all I see is a discussion of new indicators without any discussion of change in the baseline inspections, then I would be upset too. So I don't know, some of the arguments there, they just struck me as being inappropriate. Obviously, you don't feel the same way.

MR. McGAFFIGAN: No, well, we'll continue to --

DR. APOSTOLAKIS: The tradeoff, I think, is an essential part of the process.

MR. McGAFFIGAN: I would predict that if I'm in my fourth term here, which I'm not planning to be, we will still not have risk-based performance indicators that are functioning at 103 plants or whatever number of plants we have at that point, but that's a bet we can make.

CHAIRMAN MESERVE: Commissioner Merrifield?

MR. MERRIFIELD: Thank you, Mr. Chairman. First, I wanted to add my congratulations of the Chairman to Dr. Apostolakis for assuming the chairmanship of the ACRS. You've got a lot ahead of you and there's a lot of history with some excellent chairmen and I wish you well in that regard.

I would also in similar context want to thank Dana Powers, Dr. Powers, for an exceedingly good job as the chairman. You put in an extraordinary amount of not only what we expect of you, but more, of your own time and that's recognized and I certainly want to recognize that.

In particular, I would say that I think your chairmanship has significantly enhanced the

communication between the ACRS and the Commission and certainly as you assume the chairmanship, I hope you continue in the direction that Dr. Powers took us in that regard.

The first question I have is for Dr. Shack. I want to talk a little bit about 50.46. Clearly, as I think your slides indicate, risk informing 50.46 is going to be a complex initiative and one that's going to require some rigorous technical evaluation on our part. It's going to have far-reaching effects in Appendix K and elsewhere. In your Slide 8, you indicated that you met on the first bullet, you met, the subcommittee met on March 16th of 2001. Can you give an initial impression of how you think the staff was proceeding in its efforts relative to 50.46?

DR. SHACK: My impression at the subcommittee meeting was that I thought there was a good discussion going on. The industry, I think, has a strong argument that the large break is an unlikely event. We've accepted that argument in the past for dynamic effects. We've used probabilistic risk assessments for risk-informing piping inspections and there's a reasonable experience base that shows that large double ended breaks are unlikely. I think the staff quite properly looks at and says how low does that probability have to be and it turns out it has to be pretty low and it's past your experience base, so that you really are depending on your analytical tools and there are just lots of things to consider, you know, phenomena like stress corrosion cracking that are difficult to address and so I think they're cautious about that.

My initial reaction was that they were overly cautious, going into the subcommittee meeting and listening to their arguments, I found myself much more sympathetic. I sort of appreciated their attempt. When I listen to the industry arguments, as I said, there were general agreements over things that were dealing with, for example, the start-up time requirements for the diesel generators and I thought the staff was making some attempts that they realized that and we're looking for ways that would be quicker and faster, perhaps, to get some relief, if not everything that the industry was looking for.

I came out of the subcommittee meeting with the feeling that the industry appreciated the staff's difficulty. They were willing to work with them. They understood that the level of rigor that would be required would be high and would require substantial investment and I appreciated the staff's identification of the difficulties that were associated with that. So I came out of that subcommittee meeting feeling that everybody realized we had a difficult problem, but they were working on the problem. I'm not sure that that follows from all subsequent meetings that I've heard, but that was my impression then.

MR. MERRIFIELD: Thank you. Mr. Sieber, how much involvement does ACRS seem to have relative to the review of some of the NEI guidance documents? Specifically, I'm interested in knowing where you guys are going relative to the review of NEI-00-002 which is the PRA peer-review process guidelines and 004 which is the option 2 implementation guideline. To what extent, if all, are you going to participate in that?

MR. SIEBER: Well, we have received, as I recall, a presentation on 002. And a copy of the document. I do not recall that we have commented on it specifically. Is that correct?

DR. APOSTOLAKIS: Unless we are asked to review these documents we will not do it, unless they're part of -- start plans to do less, in some way the Regulatory Guide, we generally do not review NEI documents.

MR. MERRIFIELD: That's fair. I'm not telling you one way or the other whether I think you should, but it's one I will further consider in that respect.

DR. APOSTOLAKIS: If you ask us, that's another way of doing it.

MR. MERRIFIELD: That will be up to the Commission to do that.

Dr. Wallis, I want to first start out by thanking you for the presentation you did today in which you correlated the impact that our codes have on the NRC performance goals. I thought that was a very good way of doing it. We had some discussion yesterday about the Research Office and some of the efforts we're doing there. I think there's a great corollary that I think our Research Office can learn from that type of approach because I think it closely aligns what we're looking at with where it meets with our goals.

You had, in Slide 28, a discussion of some of the activities associated with thermal-hydraulic codes and I guess my question for you is given your experience, where do you think we are most vulnerable in the area of thermal-hydraulic codes and what should we be doing that we're not at this point?

DR. WALLIS: I have an answer. I'm thinking about -- I think that what you're doing is the correct thing, so looking ahead to some vulnerability is something we haven't really done. I think we've focused on the vulnerabilities we see now and we have been, I think, quite severe in holding some people's fee to the fire on those vulnerabilities. If this is something new, I can't be sure.

MR. MERRIFIELD: Let me mention, too, we've got two issues that are either currently or perhaps before us. One is a significant increase in the size of power upgrades being sought by some of our licensees. We also, as we mentioned before, we have the potential for some new plant orders, some of which would be utilizing more innovative designs.

Given those actual and potential examples, looking forward to those, are there some areas you think we may need to think now about bolstering up our efforts of thermal-hydraulic --

DR. WALLIS: We have already said about power upgrades that up to now it seemed to be fairly easy, but there must be some limit somewhere and since we haven't yet seen the codes or any other prediction of where those limits would be, we are really curious about where they will be. So in the sense that we don't know where the limits are to power upgrades, I don't know if that's a vulnerability. It's something we're a little insecure about, I'd say because we haven't really seen the code sort of called to predict those extremes. We haven't seen that yet, so we don't know if there's a vulnerability or not. I think we have a little bit of concern about how far can upgrades be pushed because we haven't seen the evidence. It looks too easy so far. We haven't yet begun to push the boundaries of some envelope.

In terms of future designs, again, I think until we get more into the details of those designs it's hard to answer your question. What we have seen is AP1000. Again, we have not yet seen the comparison with code, so the hope is that AP600 analysis will work for 1000, but we have not yet seen the evidence. So we're not sure. I don't know that we're concerned about vulnerabilities. We just don't know yet.

MR. MERRIFIELD: That's fair. The following question I have is for Dr. Powers, although Dr. Shack may want to jump in on this one. We have a lot of work that's being undertaken at Argonne National Labs relative to detection technology for cracks.

It was my thought that we've been focusing primarily or one of the significant issues we've been looking at is issue of human error in terms of crack detection and analysis of test data.

Is it really a function of focusing on crack detection or crack sizing and are we focusing on the right areas, not to put you on the spot, but are we working on the right things at Argonne now or should we think, given some of the more recent evidence that we should be evolving in that regard?

DR. POWERS: We had an opportunity to examine some of the work that's going on at Argonne. It's a very exciting kind of facility they're setting up to MOX steam generator where they can have cracks that are either laboratory made or actually generated and people can use a variety of techniques, characterize those cracks that are subsequently characterized in a metallurgical sense and you run a comparison and get a lot of information about the technologies.

I think it's very worthwhile to do that work. I will comment that within the field operations, the people doing the inspections, we have a little different problem there and a little different problem is human error, as you point out, arises that the technology -- you can imagine technology is getting too complex to be used in the name of getting higher and higher accuracies. The licensee himself has a problem of he'd like to check things quickly. He's certainly finding himself with a criteria for fixing or leaving in place flaws within the confines that team support plays, but elsewhere in the facility, he's on a plug on -- essentially plugging the tubes on detection of any flaw and clearly

that's ripe for some sort of change in process there, if we can get a handle on what kinds of flaws it's okay to leave in place. The problem is the phenomenon is highly non-linear and it's non-linear in the sense that stress corrosion cracks grow very slowly, initially, and to a lateral link and then they grow very quickly and so you get this peculiar phenomena of not seeing anything in one detection and the next cycle that you suddenly have a crack.

I think our assessment of the work that's going on was at Argonne was all appropriate for -- we found all the work at Argonne was necessary and indeed all the work that was going on in steam generators was quite appropriate at the Office of Research. We did suggest some other areas that they expand into and apparently an action plan is being prepared in that regard.

Bill, did you want to say anything?

DR. SHACK: In my own vested interest, I do think that detection is the critical issue, that you know, I'm not so much worried about the flaw that's inside the tube support plate that I know about. I'm worried about the flaw in the U-bend that I missed in the inspection and so to my mind, improvement in detection is the critical issue. If you're going to avoid tube ruptures as Dr. Powers -- I don't think we can ever completely avoid them. The statistics are just against you, you know. And what we're finding in our Argonne research is that at least in the best circumstances, people do a very good job of detecting significant cracks. We probably can't -- that's the one thing we can't model very well in our mock up is the human area, the pressure to do the job, you know, it's a different sort of situation. So I think there's an important need to assess the capability to reduce the possibility for human error. Industry is going that way. We've already had some advance techniques where Z-tech and MHI have come to Argonne with the ray probes and different software that will help increase that and so I think that I still think that is the first line of defense in steam generators is first you detect the cracks. Then we can argue about what to do with them. But until we've detected them, we have no discussion.

DR. POWERS: But I think you cannot take simply vast improvements in our technology and detection and not have this debate about what to do. We'll pull every steam generator tube we have out.

You can't divorce the two. It can't be so antiseptic. And I think that's the next challenge is to approach the -- a better characterization of the tubes, of flaws in tube is going to be coupled with now what do you do with it.

DR. SHACK: Well, if I wave the flag, we have some done work at Argonne and better characterization of the flaws.

MR. MERRIFIELD: That will be our final comment then. I just want to say for my final comments, I do want to say that ACRS is clearly a learned and learning organization. I think that in the time that I've been here, going on three years, this is the most succinct and useful of the briefings that we've gotten from all of you and I think it is very good. So thank you.

CHAIRMAN MESERVE: Well, I'd like to just repeat what Commissioner has said, that this was a very helpful presentation and I also want to express our appreciation to all of you. I know that this is a great burden that we place on you and we get great benefit from it and I want to express, on behalf of the Commission, express our appreciation to you for your hard work.

With that, we're adjourned.

(Whereupon, at 12:38 p.m., the meeting was concluded.)