UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

***

MEETING WITH

ADVISORY COMMITTEE ON NUCLEAR WASTE (ACNW)

***

PUBLIC MEETING

***

Nuclear Regulatory Commission

Room 1F-16

One White Flint North

11555 Rockville Pike

Rockville, Maryland

Tuesday, July 21, 1998

The Commission met in open session, pursuant to notice, at 1:33 p.m., the Honorable SHIRLEY A. JACKSON, Chairman, presiding.

COMMISSIONERS PRESENT:

SHIRLEY A. JACKSON, Chairman of the Commission

NILS J. DIAZ, Member of the Commission

EDWARD McGAFFIGAN, JR., Member of the Commission

STAFF AND PRESENTERS SEATED AT COMMISSION TABLE:

B. JOHN GARRICK, Chairman, ACNW

CHARLES FAIRHURST, Member, ACNW

GEORGE HORNBERGER, Member, ACNW

R.G. WYMER, Member ACNW

JOHN LARKINS

JOHN C. HOYLE, Secretary

KAREN D. CYR, General Counsel

ANNETTE C. VIETTI-COOK, Assistant Secretary

P R O C E E D I N G S

[1:33 p.m.]

CHAIRMAN JACKSON: Good afternoon, ladies and gentlemen. Commissioner Diaz is running a little late and he asked that we begin.

Today the Commission will be briefed by the Advisory Committee on Nuclear Waste on several technical issues related to the management and disposal of radioactive waste. The Commission looks to the ACNW, as it is called, to provide it with technical advice to ensure the safe

management and disposal of this country's radioactive waste.

The Commission was last briefed by the ACNW on December 18th of last year. We seem to have a long time period between these briefings.

Today's briefing will include discussions on four topics that are of great interest to the Commission. These include, first, the ACNW's views on risk-informed, performance-based regulation. Second, the interim guidance in support of the final rule on radiological criteria for license termination. Third, the NRC's waste-related research program. And, fourth, the near-field environment and performance of engineered barriers in a high-level waste geologic repository.

In addition to these discussions, the ACNW will also address its plans, priorities and accomplishments for

fiscal year 1998 and its plans and priorities for fiscal year 1999. The Commission looks forward to interacting with you on all of these topics.

And unless my colleague has any comments, please begin, Dr. Garrick.

DR. GARRICK: Thank you. I agree with you it has been a little bit too long since we have had a chance to meet, and I think the resources in here are adequate to do something about that, so we will try to do that.

We are going to first talk to you, as you indicated, about the positions of the Advisory Committee on risk-informed, performance-based regulation, and we have been pretty direct and outspoken on those positions in a number of letters.

CHAIRMAN JACKSON: Good.

DR. GARRICK: And what I want to do is just kind of reiterate our views on some of the key points having to do with this approach. So in my first exhibit, I point out that we as a Committee strongly support whatever we can do to enhance the language of this discipline, and important to that is moving towards a common terminology. And we have been very encouraged by the Commission's view on wanting to do that as well. So I think that will help the process a lot.

We have also expressed our position several times

that we believe that as we move towards a risk-informed, performance-based method of operation, that it will give us a basis for making our regulations more efficient and moving in the direction of some form of optimization of the regulations.

As we have said on a number of occasions, and as you have also said, it is very important that if the agency is going to move in this direction, that we do it in such a way that the language applies to everything essentially that the agency does. So even though this activity had its birth in and has emerged primarily from the reactor business, the underlying principles are sufficiently basic that they can apply to, we believe at least, all of the activities of the agency.

CHAIRMAN JACKSON: Please.

DR. GARRICK: Yes.

COMMISSIONER McGAFFIGAN: Dr. Garrick, we had a stakeholders meeting last week, and I don't know -- I saw some ACRS members there. I am not sure whether you all were there. But we asked about risk-informing Part 50, and I think the answer that we got was that there are some -- let's finish what we are doing now, get these various Reg.

Guides out and working. Dr. Remick said there may be an opportunity in Appendix B to strip some stuff out that the maintenance rule may be now adequately dealing with.

6

But there wasn't a lot of enthusiasm for a comprehensive rewrite. And it strikes me that what I am learning, and you said earlier that it came out of the reactor side, but in some sense, the waste side has gotten ahead of that reactor side because it is a new area.

DR. GARRICK: Yes.

COMMISSIONER McGAFFIGAN: It is easier to bring this new framework into an area where you are starting from scratch than it is where you have a large body of work already there and the stability of the regulatory framework, however deterministic and prescriptive, and whatever it may be. Better the devil you know than the devil you don't tends to become a counter-wait.

Do you have any thoughts about that? As I say, you'll have to take my word that that was the general consensus of some of the industry folks. And you might not have concurred in it if you had been present, but whatever.

DR. GARRICK: Well, I think that you are correct in that the waste field has some advantage, particularly on the performance side, because the standards are basically performance-based, and the primary activity has been in the high-level waste arena and that is where most of the attention has been given with respect to establishing a performance-based standard. So I think there is an advantage.

7

On the probabilistic side, I think that the waste side has had some catching up to do, and I believe they have done a very good job of that. And I think they have been sometimes frustrated by not being able to capture as much of the methods that come out of the reactor business and transfer those to the waste business, as some would like. But, certainly, some of the fundamental principles, they have been able to do that.

As far as the question of how fast we should move, I think that it is very difficult when you have got a system that seems to be working, that people are well-skilled in, trained. It is difficult to talk about change, and I think there will be a natural resistance to that. On the other hand, you would certainly expect that from me.

I think the change is justified. The benefits for doing so are there. I think we are in a time of metrics and measurements. I think the risk-based process gives us a much better basis for measuring our performance and being focused in terms of having reasonable confidence that we are dealing with the right priorities. So I expect that. I expect there will be a resistance and people saying that maybe we shouldn't go make substantial change.

And I think we have to be very selective where we make the change and what-have-you. And I would hope that one of the areas where there would be rather quick change

8

would be in the analysis activities that are ongoing. There is no reason that all of our analysis activities shouldn't be risk-informed right now, regardless of the regulations. I would like to think that a comprehensive, risk-oriented analysis contains within it all that is required for the existing regulations.

But I hope, as you will see in a moment, that we

move in a direction where maybe some of the existing regulations can either be simplified or even eliminated.

CHAIRMAN JACKSON: So let me make sure I understand your point. There are really two. One is that you believe that even within the existing framework, that essentially all of the analysis can be made risk-informed.

DR. GARRICK: Yes.

CHAIRMAN JACKSON: And that the second point you make is that there are some selected regulations that should be or could be made risk-informed.

DR. GARRICK: Yes.

CHAIRMAN JACKSON: Even if we don't do a comprehensive rewrite of Part 50.

DR. GARRICK: Right.

CHAIRMAN JACKSON: Could you speak to where you think some of the opportunities are?

DR. GARRICK: Well, certainly, we heard a lot on that reactor side about Part 50 and about trying to embrace

the safety goals more directly into the regulatory process. There has been lots of talk and discussion, and even work towards elevation of the core damage frequency as a surrogate of risk, and all of that is related in one way or another to Part 50.

In the waste side, I think the differences that are probably going to manifest themselves between the existing Part 60, for example, and what we expect in the new regulation, Part 63. Some of those are clearly going to be driven by risk-informed interests and performance-based.

I think the idea of moving away from the allocation of performance requirements to subsystem levels is another direct indicator that we are moving in the direction of a more performance-based and risk-informed approach. So I think we are beginning to see things happen and those are a couple of the regulations that I think would be most -- most directly impacted.

CHAIRMAN JACKSON: You also speak to the fact that you feel that the concepts need to be sufficiently general to accommodate all NRC activities. Do you feel that, and I know you have had some interaction at an earlier incarnation, but do you believe that the concepts and definitions embodied in now the staff white paper on the risk-informed, do you think they are general enough to accommodate those?

DR. GARRICK: I think -- yes, I think that is very much in the right direction. The version that I have seen, I am very encouraged. I think it clearly has a stronger orientation to risk than -- and performance than any similar paper that I have seen.

CHAIRMAN JACKSON: And the last question, we did have a Commission meeting a couple of weeks ago on PRA and the propagation of it into materials-related areas in particular, waste management areas. Do you agree that -- or do you believe that the staff has a comprehensive plan or a comprehensive framework for using risk-informed approaches to optimize our regulations and regulatory approaches, including analyses, in these areas?

DR. GARRICK: Well, being sometimes accused of being a zealot in this discipline, obviously, I am never satisfied. And I think that, you know, there is a desire always to see progress and more progress. But I have followed what has been going on, and both facilities, the nuclear waste facility side and then the reactor side, and

have been very encouraged that -- with most of what is being done.

I have also been encouraged by the fact that, for example, the ACRS has capability in this arena that they haven't had in the past, and I think that is very, very helpful.

So I think there is a lot of work to be done, but I see some of the fundamental building blocks being put in place, and the white paper is clearly one of those.

COMMISSIONER McGAFFIGAN: One of the points you made a few minutes ago was that you think there could be a quick change in the ongoing analysis activities of the agency regardless of the regs. We are dealing with one at the moment, 50.59, where if you have any ideas as to how to make that quick change, they would be welcome, because we are having a heck of a time. We have this design basis analysis that is the fundamental --

DR. GARRICK: Right.

COMMISSIONER McGAFFIGAN: -- sort of stylized analysis that underlies that and the whole -- the whole of Part 50, really. And the Commission, sort of naively, in its SRM said, well, you might be able to look at some of the work you did on Reg. Guide 1.174 and try to define --

CHAIRMAN JACKSON: Right. Go forth and do good.

COMMISSIONER McGAFFIGAN: Define minimal and sort of the same sort of notion you just threw out, and we are not there yet.

DR. GARRICK: Yes.

COMMISSIONER McGAFFIGAN: Dr. Aposotolakis in the ACRS has thrown something across the transom that may help, but we are struggling with how you build in, even in our

analysis, a risk-informed analysis to deterministic prescriptive regulations.

DR. GARRICK: Yes.

COMMISSIONER McGAFFIGAN: And the design basis accident analysis.

DR. GARRICK: Well, I have to live my colleagues here, and for me to really get into 5059, --

COMMISSIONER McGAFFIGAN: I know.

DR. GARRICK: -- I might spend the rest of the day. But I think -- I am a great believer in the top-down approach. I think if we come to grips with some fundamentals and some policy issues, and some methods, and the staff begins to embrace those and get trained in them, that, you know, we will see solutions that we didn't see before.

Now, I will comment on a couple of things that you mentioned as I go along here. Fortunately, the questions you have asked has allowed me to cover most of what I have just covered. So I think we are in pretty good shape.

So let me return to the exhibit on risk and risk assessment. I am a great believer that in any science if the science is to move forward, you have to have some way of measuring and risk is no different than that, and the more the measurements can be in terms of fundamental principles, first principles, the more broadly it will apply to systems

that we have to worry about, so I think the encouragement here is to not get locked into a single measurement necessarily that constitutes what we mean by risk, because it usually does not quite do the job.

One fundamental that we have seen work very well in the applications arena is something we call the triplet definition of risk. Whether we have been analyzing the risk of importing agricultural animals and the implications that has on disease rate or whether we are analyzing the space shuttle or a chemical refinery or a nuclear power plant, the triplet definition of risk has applied and been a very constructive framework within which to ask the important detailed questions -- what can go wrong, how likely, what are the consequences approach in practice has seemed to work very well.

Given that that is kind of what one might assume is a definition of risk, I also like to look upon it as containing the definition of deterministic safety analysis. Even in the old days when we were doing safety analysis of nuclear power plants, long before PRA, we used to ask the doublet question -- what can go wrong and what are the consequences? -- so in the context of the triplet, what we like to say is it's not a question of deterministic versus probabilistic. It is a question of whether or not you want to deal with the question of uncertainty and likelihood of a

safety analysis and if you do a safety analysis becomes a risk analysis -- so that is an example of a general kind of fundamental notion.

CHAIRMAN JACKSON: Go ahead.

COMMISSIONER McGAFFIGAN: Before you leave the slide, the triplet definition of risk, if we adopt -- I remember being taught risk is probability times consequences for an individual event. It's the same thing -- what can go wrong --

DR. GARRICK: Yes.

COMMISSIONER McGAFFIGAN: But how important is it that we develop a common definition across agencies, health agencies, FDA, FAA, EPA, et cetera so that we are not speaking past each other?

There is this report I think Gil Olman put out a year or two ago --

DR. GARRICK: Yes.

COMMISSIONER McGAFFIGAN: -- about risk and I think it talked about some of this stuff, but we are -- are you suggesting we just go ahead or do we try to foster a common language or how do we do what we do in the context of what everything else is doing?

DR. GARRICK: I don't know that I would suggest that we force anything. I think that it is a concept that has worked well and generally concepts that work well are

adopted and spread and become standards.

I have never been to one to think that there was so much wisdom as to be able to know what the ultimate definition ought to be, so I would think that if the agency has lots of success with this way of thinking, this kind of definition, that it would be adopted by others.

As a matter of fact, the definition I am finding is finding its way into a number of other arenas, including defense and NATO -- I have seen it in NATO documents -- chemical and so forth, so I think that there is enough evidence out there that the idea has enough confidence behind it or it wouldn't be suggested, that its acceptance is not taking anybody out on a limb very far, but my preference would be that the language would be standardized. At least we would move in that direction.

COMMISSIONER DIAZ: Yes. Besides the definition

of risk, of the triplet, in your set of fundamental principles is there anything else you could put on the table that would be more specific what you mean by fundamental set of principles?

DR. GARRICK: Yes -- well --

COMMISSIONER DIAZ: Measures needed to be interpreted in terms of --

DR. GARRICK: Well, yes. One thing that I'd put out on the table in the risk business is that I am very much

a believer in evidence-based risk assessment. I think that what we want to do is to have our risk assessments be impersonal, not be dependent upon opinions and politics, religion, or anything except the supporting evidence, so I think the evidence has to speak for itself.

I think that in order to do that you can very often enhance that process by the tools you select to process that evidence, and they need to be transparent and that not only means transparent with respect to the specific exercises that you go through, but transparent with respect to the logic that you employ.

You know, this is the thing that sets risk assessment apart from a lot of the other analyses that have risk principles in them, and that is that usually in the risk field we are trying to calculate something about which we have very little or no information, and so what we have to do is map that requirement, that number or that outcome that we want down to where we have some information, and it is that mapping that needs to be visible and if the logic is visible and the information is clear, then of course you move in the direction of transparency.

CHAIRMAN JACKSON: Let me ask you two questions. I mean I think I understand what you are trying to say.

One theoretically could say that superficially there seems to be an inconsistency between, say, using PRA

to complement our traditional deterministic approaches, which is what we talk about sometimes, and secondly, using what you say is treating deterministic approaches or analyses as a subset of risk analysis --

DR. GARRICK: Right.

CHAIRMAN JACKSON: -- and it seems that the resolution of that apparent inconsistency is in your triplet definition, namely that you are basically arguing that a deterministic analysis or approach answers the first and the third question and that PRA answers or attempts to answer all three.

DR. GARRICK: Right.

CHAIRMAN JACKSON: So it is in that sense that the deterministic analysis is the subset --

DR. GARRICK: Yes.

CHAIRMAN JACKSON: -- but it's also in that sense that PRA is the complement that allows you to add in an answer to the third --

DR. GARRICK: Right.

CHAIRMAN JACKSON: -- to the second question, is that right?

DR. GARRICK: Yes. That's right.

CHAIRMAN JACKSON: Okay. Then the second question I wanted to ask you is you spoke about evidence-based risk assessment and of course one could raise the question of the

use of expert panels and expert judgment, and is the point

you are making that this mapping needing to be made visible and therefore the transparency of the logic, as you call it --

DR. GARRICK: Right.

CHAIRMAN JACKSON: -- is that the way that one justifies and makes the best use of expert judgment?

DR. GARRICK: That's part of it, and you will notice I did not use the word "data" because data conjures up certain specific things in people's minds, and data is a piece of evidence, but it is not the totality of evidence.

The laws of physics are evidence, logic is evidence and expert elicitation outcome is evidence --

CHAIRMAN JACKSON: Okay.

DR. GARRICK: -- so I think that is what I was referring to.

CHAIRMAN JACKSON: Okay.

DR. GARRICK: All right. Let's go to risk assessment and defense-in-depth.

We have written to you much about those topics.

One of the things that we see as an advantage of a risk-informed approach is the opportunity to add clarity to the concept of defense-in-depth, the opportunity to move in the direction of quantifying the contribution to performance of all lines of defense.

Of course, when we talk about quantification we are really not talking about necessarily a property of the real world so much as we are about the knowledge of the individual or individuals and their ability to express that knowledge, and in order to express knowledge about rare events you have got to have a mechanism and a form to do that that captures the fact that there's lots of things you don't know or the fact that there are uncertainties, so quantification doesn't necessarily mean a number. It means capturing the information in a form that conveys what you do know as well as what you don't know, and some of the lines of defense you are going to know a lot less than others, and if you have a way of communicating that, then you have a real heads-up on the notion of defense-in-depth.

On risk-informed, performance-based terms, the committee is very much in agreement with the positions we have seen articulated by the Commission on the fact that a risk analysis is not necessarily decision analysis. Many more things often go into a decision.

In risk there is always the opportunity to define your risk parameters in such a way that they embrace issues of cost and issues of schedule. That kind of activity has carried with it a whole new field called performance risk analysis or programmatic risk analysis, but one has to be very careful about using risk in decision-making and making

sure that it is in its proper context.

Performance-based -- there are major differences between materials and reactor licenses in the case of performance-based regulations. I think we spoke to that at the opening, that there's things that have been established by tradition through the reactor field that have to be dealt with in probably an evolutionary manner to move to the risk-based way of thinking.

I think one of the primary compromises, if you wish, of the doublet view of safety analysis is that interpretation of design basis. I think if we had not come up with the concept of a design basis accident, I think the coupling between safety analysis and risk analysis would

have been much easier to see.

Regulatory burden -- I think that most people who are mature about this discipline and practice it look to relief in regulatory burden. They certainly don't look to a relief understanding what the safety is, on the contrary convinced that there will be much more knowledge about the safety, but that eventually there needs to be some efficiencies as a direct result of risk-informed practices and those efficiencies need to take the form of changes in the regulations.

So as to my closing comments, I think that we have indicated a number of times that we think the risk view is

essential to judge the overall safety of a repository. It provides us the perspective we need.

I think one of the things that is sometimes underestimated is the experience base in the waste field. While the use of probabilistic methods in the waste field has come relatively late, the amount of activity has been intense and the expenditure of effort, resources in the last 10 years, primarily through two projects -- the Waste Isolation Pilot Plan and the Yucca Mountain, proposed Yucca Mountain repository.

As a result of those activities we have learned an enormous amount about how to apply these methods to a geologic system, and as we said, one of the things that is very important in evolving and transitioning to a risk way of thinking is to not prescribe yourselves out of the business. We need to retain a certain amount of flexibility.

As to the details, even though we have been arguing in my whole discussion here about the importance of fixing some principles and the way we do some of the analyses and the details of some of the methods -- that aspect of it needs to be flexible.

I think that's all I want to say about the subject and I am certain available for questions.

CHAIRMAN JACKSON: Okay.

COMMISSIONER McGAFFIGAN: I am not sure you ever answered the Chairman's question about where the low-lying fruit are in reactor space, but maybe your answer was that your colleagues would get mad if you took all afternoon on the subject, so --

DR. GARRICK: I think one of the areas is to -- okay, I will answer that.

I think the design basis accident philosophy approach to regulation is sometimes a barrier to the introduction of a risk-informed approach, and I think that is a specific that you started to look at the regulations in the context of design basis that you would maybe appreciate that this is the one activity, this is the one analysis, effort that has compromised, if you wish, an otherwise doublet approach to safety analysis, and I know why it came about and how it came about and that it was useful but it created partitions that were artificial.

We got into class 9 accidents, severe accidents and what have you, and these sort of artificial interfaces that don't really exist in nature. And that we started regulating against a design basis accident as if we did that we would never have a severe accident. And we of course learned that that's just not the case. So that's one major issue that I would love to work with you on.

CHAIRMAN JACKSON: Well, would you -- we'll give

your colleagues plenty of time. Would you care to speak to 50.59?

DR. GARRICK: Well, I think that what you're trying to do, namely it's like somebody has said if somebody comes in for a change, even though we are not under a risk-based regulatory process right now, such changes cannot be realized anymore without some level of a risk analysis. And I would like to see the 50.59 activities move more aggressively in that direction to where there was increased dependence on that, and I think also there would be great signals sent out to the licensees if with that came a real examination of 50.59 in terms of its deterministic, in terms of its traditional requirements.

I think that one of the things that is causing quite a bit of anxiety, and I'm sorry I wasn't to the meeting last week, is that many people are discouraged about risk on a couple of counts. One is this whole idea of keeping a comprehensive risk assessment current is viewed as an extensive burden, and, two, and this involves the NRC, it's not clear to a lot of licensees just what the benefit is, that if they have to go ahead and comply with all of the so-called deterministic requirements, they're not so sure, given the maturity of the industry, that they want to engage themselves in a research-oriented kind of activity just for the sake of building confidence in a risk-based approach to

regulatory practice.

So my view on this is that probably the pilot programs you have are useful. They provide a lot of insights and problems learning about the application of risk to a whole family of issues, everything from hydrogen recombiners and their necessity to the utility of a graded quality assurance program. But I think that the thing that would really advance the cause would be some rather significant backoff, if you wish, or modification if you wish of a regulation that is a heavy burden, on the basis that you're now confident that what was being sought as a result of that regulation is more than offset by the new methods and the new practices.

CHAIRMAN JACKSON: Okay. Thank you.

Dr. Fairhurst.

DR. FAIRHURST: Thank you very much.

What I'm going to address is clearly a restatement of material communicated in a letter in April. That was based on a presentation in March from the Office of Nuclear Regulatory Research concerning interim guidance and the support of the final rule on radiological criteria for license determination -- license termination, sorry.

I first lay out the several general observations. One, that obviously decommissioning is a subject that's going to be of continuing and probably growing regulatory

importance. Secondly, that the license termination issue is a complex one, varies very widely from case to case from very simple determinations to really quite complex situations. And the NRC resources required to deal with it are correspondingly quite varied.

Then the next observation was really a picking up a little bit on what Dr. Garrick's constant philosophy is that we need to be dealing with a risk-informed, performance-based criterion. This is another case where the changes that are envisaged are along those lines. That's

not saying there is some need for -- there is a need for regulatory consistency with respect to the use of the total dose standard basing things on health effects, having some flexibility in the regulatory approach because of this complexity, and also in this particular case recognizing the role of Agreement States. They, too, feel they have a stake in it.

An issue that was brought to us and which I know you're very familiar with, but it was raised first by the industry, nuclear energy industry, was this question of dual Federal regulation, and that this is a serious problem and one that is not easy to deal with, but somehow is going to have to be dealt with.

The main recommendations in our letter, first we were somewhat overawed by the complexity of the regulatory

guidance. I think the word we used was it was formidable. I think you responded in kind and said yes indeed you understood it and that maybe it needs to be -- need to take some advantage in this electronic age of finding ways to make it more comprehensible, user-friendly, and a little more menu-driven format.

Another issue that we felt we needed to bring out was that the ALARA approach maybe should be considered to be in some cases leading to unnecessary conservatism, and we feel that if you could meet the 25 millirem all-sources or pathways limit, that should be sufficient. I think in your answer to us you mentioned a concern or a feeling that in some cases if it was a simple thing to do, then one could perhaps go lower if it was a question of just wiping things down. But I think we still hold to the notion that that 25 millirem should be for most cases sufficient to meet what we'd call ALARA.

COMMISSIONER DIAZ: Could you please elaborate on the reason why you believe that it's possible or it's justifiable?

DR. FAIRHURST: Well, yes. In the -- first of all, the doses that one receive from 25 millirem from all pathways I think generally would be considered to be of little concern as far as health effects.

COMMISSIONER DIAZ: Yes.

DR. FAIRHURST: There is also I think the feeling that the formula rem standard ground water but if you use the 25 millirem all pathways, it probably will in many cases satisfy the formula rem. I'm not an authority in this, but it's what I've been led to understand, that if you look at the requirements that are being suggested by people that this is not a major deviation from those in most cases.

COMMISSIONER DIAZ: But it's the ALARA interface, what I'm concerned, we always put the ALARA interfaces and the additional satisfaction of --

DR. FAIRHURST: Well, yes, you know, ALARA, as low as reasonably achievable, and one can then argue, Dr. Garrick wants evidence, wants facts, reasonable is a very subjective word, and the question is what is reasonable. And you can force somebody out of business perhaps financially by pushing them to an enormous amount of effort for very little benefit.

COMMISSIONER DIAZ: We have a long history of using ALARA.

DR. FAIRHURST: Pardon?

COMMISSIONER DIAZ: We have a long history of

using ALARA.
DR. FAIRHURST: Oh, yes. Yes, I'm just saying that --
COMMISSIONER DIAZ: We've managed to keep it

within bounds.
DR. FAIRHURST: Right.
CHAIRMAN JACKSON: Well, I mean, isn't also if I go back to what Dr. Garrick was saying, that if you talk about using risk analysis or, you know, today, particularly within the ALARA framework, does that not offer a way not to abandon what has been a cornerstone of how we've done our business, but at the same time address the issue of unnecessary conservatisms from a cost-benefit point of view?
DR. GARRICK: Yes, and one thing that's very important, and I'm sure that Charles was going to comment on this, is that when we say in reference to this specific issue that the 25 rem is acceptable, that's not saying that we don't believe in ALARA. ALARA is a rational way to look at things.
CHAIRMAN JACKSON: That was my point.
DR. GARRICK: If you can meet a standard and spending 10 cents reduce it by 10, of course you would do that.
CHAIRMAN JACKSON: Right. That's all.
DR. GARRICK: Yes.
COMMISSIONER McGAFFIGAN: This is a more generic question, but I will point out you were listened to by the Commission. Our staff requirements memorandum on this particular point uses the word "may." It isn't quite as

definitive as definitive as you, but in addition if the licensee complies with the 25 millirem dose criterion using the screening methodology, the D and D code which itself is quite conservative, the licensee may have met the intended ALARA requirement. May have met. We didn't, you know --
DR. GARRICK: Yes.
COMMISSIONER McGAFFIGAN: Therefore additional demonstration of compliance may not be necessary. So we did listen, but we also wanted to take into account by using those mays the circumstances where for 10 cents you get a factor of 10 --
DR. GARRICK: Yes. Absolutely. Absolutely.
CHAIRMAN JACKSON: Okay.
DR. FAIRHURST: And the final point that was made in the letter was that we felt that the D and D code that is being considered should have some flexibility for change if one finds, for example, that the foundations on which it's built change, such as the linear no-threshhold hypothesis. And your response I think was that if that is changed, it will have other ramifications apart from just modifying the D and D code, and we know it will.
We also recommended that it would be useful to try to take some test sites, complex test sites, and go through the implementing guidance and see how it works out in reality. There was a suggestion made that there might be

some level of conservatism by using generic parameters and it might be possible and simple to locally add regional parameters, it might reduce the conservatism.
I might add in conclusion that yesterday we heard a presentation from the NRC staff about developing a standard review plan, and it appears that things are moving quite well along where they are about to test it on a

complex site and they are considering a number of things to improve flexibility. So I think this is on course.

CHAIRMAN JACKSON: Yes. Thank you.

COMMISSIONER McGAFFIGAN: Did they give you a copy of our SRM too at some point, because a lot of that was directed so that -- just so you know that your advice is listened to, a lot of the thoughts in the SRM I think and part of all of us was the result of your work and very much appreciated.

DR. GARRICK: We are encouraged.

DR. FAIRHURST: So we will give you an update later, I think, not just back-patting but we did very much appreciate your response and comments to us on that. It was helpful. It tells us that there is somebody listening and responding. Thank you.

CHAIRMAN JACKSON: Of course. Somebody up here even likes you.

[Laughter.]

CHAIRMAN JACKSON: That always helps.

Dr. Hornberger.

DR. HORNBERGER: Thank you, Chairman Jackson. As always, it is a pleasure to be here.

My task today is to report to you on some of the work that the ACNW did in looking at the waste-related research program within NRC. And this was, as you know, ACNW input to an ACRS report. ACRS was asked to review safety-related research and they asked ACNW to look at the waste-related portion.

The Office of Research has a fairly modest program, mainly in decommissioning and decontamination, and the ACNW did hear presentations from staff of the Office of Research on that.

The NMSS, of course, classifies their work as technical assistance, the work they do with the Center for Nuclear Regulatory Analysis. But we are familiar with that work mostly because we have been keeping track of the work related to Yucca Mountain, and a lot of that work we judge as quite innovative and very important, and so we classify it -- or we decided to include that under research. And, so, of course, we have had regular presentations and interactions with staff of NMSS.

We also had a meeting where we had some briefings from the Department of Energy with regard to their waste

management research. This is not the Yucca Mountain, but this is a program that was done between their Office of Research and the Waste Management Division to sponsor basic research. And we also heard from EPRI, the industry side of the house, on how they conduct their research program.

So that is the background, just so you know what we did to come to some of the observations that we had -- that we have listed.

The observations with respect to NMSS then, as I very quickly summarize out of the report, it is obvious that the Department of Energy has the big job in terms of coming forward with a license application for Yucca Mountain and their research program, obviously, has to show that. So that their research budget is much, much larger than the NRC budget.

We took -- one of the reasons we took a look at EPRI was because EPRI has a very -- also a very modest research program, and we were interested in the way they

handle it. Of course, from the industry side, they have lots of flexibility, they have almost no constraints, and so they use performance assessment to prioritize the topics that they go after and then they simply go out and find the best person that they can to do the work that they want to, and they contract with that person. And, clearly, the NRC simply can't have that kind of flexibility.

But one of the observations that we did have was that the research and technical assistance programs within NRC really do have to be focused and flexibility and carry the respect of the scientific community. And, obviously, the NRC has to continue to have national and international stature in the whole waste management area.

CHAIRMAN JACKSON: Let me ask you a question. I noted that you made a number of some specific recommendations and one of them was, this goes back to high-level waste, you said -- well, and more broadly, actually. You said that the performance assessment model should be structured to represent repository performance as realistically as possible.

I mean is there an implication there that the NRC is not using realistic assumptions or realistic models? Or is this just kind of an overall --

DR. HORNBERGER: No, actually, I think that we did have that comment in a previous letter and we continue to believe that the NRC, the staff must continue to strive to be as reasonable as possible -- as realistic as possible, excuse me, and to ferret out any conservatisms that are built in and make sure that they are appropriate conservatisms.

CHAIRMAN JACKSON: So it is really a question of following a line with some modulation, --

DR. HORNBERGER: Yes.

CHAIRMAN JACKSON: -- as opposed to that they have been on entirely the wrong track?

DR. HORNBERGER: Oh, no. In fact, quite the opposite. We think that they are very definitely on track.

CHAIRMAN JACKSON: Okay. I just wanted to be sure.

DR. HORNBERGER: I think the first bullet in terms of recommendations, really, really should -- NMSS should continue to focus their technical work.

CHAIRMAN JACKSON: Okay.

DR. HORNBERGER: They have been doing an excellent job, by the way, in using the TPA, their total performance assessment code, to look at the priorities, to continue to assess the key technical issues and the sub-issues. And they have used it -- I had a chat with Margaret Federline, I guess in April, on this, and she said, yes, they do look at these results and they do have -- they try to maintain as much flexibility as they can to redirect work at the Center as appropriate. So --

CHAIRMAN JACKSON: Well, a concern I had had relative to the TPA was the data that the NRC had available to it, because in order to be realistic, you have to have data that tells you something about the site you are trying to model. Do you have any comments or concerns in that

particular area?

DR. HORNBERGER: Yes. I mean, clearly, of course, the DOE, their TSPA suffers from exactly the same problem. So it is not just NRC TPA, but it is the DOE and, of course,

EPRI uses their total performance model and they have exactly the same kind of constraints.

I think that there are clear areas where the database is sketchy, shall we say, and I think that Ray probably will highlight at least a couple of areas where we really -- we think that probably the database with regard to engineered systems, in particular, definitely needs work.

The NRC obviously can't afford to collect all of those data, they have to be very select in terms of what they focus on. And I think that is the focus and flexibility issue that we raised with respect to the high-level waste.

CHAIRMAN JACKSON: Is there more opportunity with making use of data that DOE itself generates, but in our -- in the models?

DR. HORNBERGER: Yes. Oh, absolutely. Charles and I just were up on the seventh floor at lunch and had a demonstration of the three-dimensional geological model for -- that was developed by DOE. And the NRC is verifying this and basically considering what the criteria will be for them to accept it into their own use. And so DOE invested a huge

amount of money to develop a tool that is I think going to be very useful for the NRC, as one example.

CHAIRMAN JACKSON: Thank you.

DR. HORNBERGER: So, in terms of the recommendations, as I said, the continued focus of the technical work by using the TPA. We have had clear evidence over the past several meetings that the DOE design continues to evolve and we anticipate that it will evolve as we go into the future with changes. Therefore, the flexibility with the Center has to be maintained in terms of definition of the tasks. As I said, the main flexibility that we observed with EPRI is that they had freedom to engage anyone, any expert in the world without constraints as to prior work with DOE or anything else, and NRC doesn't have that.

Nevertheless, we do feel strongly that outside experts, engaged appropriately in a surgically precise manner, again, can enhance both the acceptability, and when you get advice from world experts, really leading experts in the world, I think that it does have -- it reflects credibility onto the program by having these excellent people from the outside concur with you.

And there have been a range of letter reports and this last bullet really comes from a letter that we wrote to you on comments on performance assessment capabilities,

where we, in fact, again, identified, because of this switch -- not a switch, but the enhancement of interest in the engineered part of the system of the repository, which we believe is going to continue to become ever more important as we -- as DOE goes forward, that the NRC staff really does have to make sure that they have the right capabilities, either here or at the Center, or that they have the flexibility to engage help as they need it.

The next observation with respect to NMSS, again, it is really a repeat in the sense of the point that I just made. It is imperative that the outside world not view NRC analyses as overly simplistic. And, again, we think the ACNW believes that one way to help out in this is to engage prominent waste engineers and scientists in the resolution of waste management problem.

And, of course, we understand that funding has been an issue for years. We discussed, I think, a year ago about the decrease in funding for certain -- curtailing work on certain KTIs and this can throw monkey wrenches, obviously, into programs, and people do have to live with that. We don't have an infinite resource here. But, at any rate, we think that the Center funding has to be such to ensure that this ongoing effort is maintained.

Our observations with respect to the Office of Research, really, the first bullet here on the observation

has to do with priority setting. We heard the presentations on the research. We are impressed by the work that is being done by the Office of Research. But we thought that setting priorities and how priorities were set were a key, and it was unclear to us in our discussions whether the current structure for setting priorities was what we would consider rigorous.

We were told that certainly the staff experience and knowledge had gone into setting the priorities, and these people have had many years experience, and there is reason to believe that they are on top of things. Nevertheless, whenever -- especially with such restricted resources, you really want to make sure that you focus on the priorities. So our recommendation to the Office of Research, that we see a need for a structured organization for identifying the priorities and make sure that peer review is involved, and that it focuses on the users, because, after all, it is an applied program, if you like.

So that summarizes our input on research.

CHAIRMAN JACKSON: Thank you.

Dr. Wymer.

DR. WYMER: Thank you. My presentation today is on the near-field environment, performance of engineered barriers, particularly as they relate to the Yucca Mountain Repository. And a big part of what I will present is based

on a working group meeting that we held June 10th and 11th, a two-day meeting where we brought in experts from outside, as well as DOE and NRC and from the Center, and had presentations.

We think this topic is particularly important because of the increased attention paid by DOE to engineered barrier system performance. And it is important to the NRC, of course, because they have to keep up with things and have to license that repository, so they have to understand what DOE has done.

We also got a lot of input from the working group with respect to what are the really important technical issues, and there was a lot of sort of ad hoc discussion that wasn't even on the agenda that raised some areas that I'll get into which we thought were particularly important and relevant.

So, going to the next viewgraph, we have some general observations to start with, then I will give some specific insights that were obtained out of the working group. First, the Yucca Mountain Repository is different from other planned repositories around the world in that it is in an unsaturated and oxidizing environment, which really changes a lot of things with respect to corrosion, with respect to chemistry. Whereas, most of the repository designs are in a saturated environment which is primarily a

reducing environment, the chemistry is quite, quite

different. So that's an important difference and it puts Yucca Mountain kind of apart from all the other repository design considerations.

The other thing that George mentioned is that it's like shooting a running deer. The EBS design continually changes as the Department of Energy picks up on new facts, new importances, new emphases arise, and so every time we hear from them there's something new and it's generally in the right direction and we are glad to hear it, but it does make it a moving target so it's kind of hard to keep up with the design.

Consequently and concurrently that means that the NRC Staff has to be quick on its feet and has to have flexibility to stay abreast of this evolving situation.

The Department of Energy talks about a robust depository and our understanding of what robust means is that it is simply enough that it is not going to collapse under its own complexity and that the defense barriers, that barriers are decoupled so that if one fails, everything doesn't fail, so robustness implies as much simplicity as possible and as much decoupling as possible of one barrier from another so that you don't have in the language of the reactor you don't have common mode failure.

We think it is important, and we are not sure we

see good evidence of this out of the EBS design options, we think it is important that there be a top-down systems engineering approach rather than a bottoms-up. By that we mean that you need to set the overall goals and the overall design features at the beginning and build toward those rather than seeing a lot of details emerge and let those form your design. There is probably quite enough of that going on as there should be and attention should be paid to that in the NRC's review of the situation.

Then something that emerged that wasn't really on the working group agenda but there was a lot of discussion that it emerged as a very important issue had to do with the preclosure issues of the repository. That thing may stay open for 100 years. DOE talks about 100, 200 years -- they get a little unrealistic in my view, but nonetheless they are talking a long time into the future keeping that repository open and during that time there are a lot of issues that come up having to do with heat loading and retrievability of waste packages and during that time the repository performance features can be confirmed or denied and the NRC needs to be certain I think that it pays attention -- we think -- that it pays attention to the preclosure aspects of the repository development, which one of our expert panelists said should be an evolving thing.

He even advocated continual changes in the design

of the waste packages and then some features of the repository as information is gained over the 50 to 100 years before closure -- so this is an area where little attention has been paid by either DOE or NRC as far as we have been informed to date and we think that it deserves attention.

On the next exhibit here, we get into I guess near-field environmental issues, and by that we mean anything from the concrete liner of the drift on in -- anything inside there is what we define as the near-field.

One of the things that came out and our first reaction, my first reaction to it and I think maybe the committee's, was that gee, this is kind of obvious, why are

you telling us this, is that it is very important how much water comes in and how much contacts the waste. Well, you know, that is what we call a privileged glimpse at the bleeding obvious, but when you think about it and you think about what DOE is planning, it turns out to be worth paying attention to. They are talking about a drip shield. They are talking about potentially backfills and they are talking about the effects on solubilization and transport of fission products and all this relates to water, so anything you can do to control the water is important and that is beginning to get a fair amount of attention, and I will say a little bit more about it.

There was some concern expressed about the

abstraction from the PA models, from the near-field process level models, into a PA model. The concern was, first, is the fullblown model adequately supported by data, a point that we dealt with a little bit earlier, and second, is the abstraction to this more simplified model done well? Does it really incorporate all of the salient points in the process level models? -- so we thought that attention needed to be paid to that. Now there is a great deal of attention going into that but nonetheless it was brought up and we thought it deserved mentioning here.

The near-field chemistry is near and dear to my heart and there is a lot of chemistry discussed, even though one of the participants characterized the meeting as a "corrosion meeting" -- he was a corrosion expert and my answer to that was to a hammer everything is a nail -- and he felt it was a corrosion meeting.

Actually, there is a lot known about the chemistry of the water entering the repository but there is not much known at all about what happens to that water when it starts hitting things inside the repository, especially at mechanistic level. There's a lot of empirical and anecdotal information but there is not a lot of true basic understanding of the chemical reactions that the in -- flowing water will bring about as it contacts in particular the fuel material.

Those reactions are extraordinarily complex and are poorly, poorly understood on a fundamental level.

The next exhibit here deals with corrosion. As I said, one of the participants felt it was a corrosion meeting and it was very heavy on corrosion, and partly that is because there is a lot of expertise on corrosion both within the NRC and its contractors and at DOE.

There are good people doing good work on corrosion and there is a lot of interaction between those people but you need to distinguish, we feel, between a good expertise and a basic understanding of corrosion issues and specific understanding about specific corrosion problems relating to specific materials. That gets into the next point on this exhibit, which has to do with the wonder alloy C-22. That is a high nickel based allow which has received a great deal of attention. It is extremely corrosion resistent.

I call it a wonder alloy. It is sort of a -- without tongue-in-cheek, it's a very good material. However, the information base with respect to corrosion is limited with respect to the amount of time that people have been studying this material -- something less than two decades, which is a whole lot less of course than people have looked at iron and titanium and other kinds of alloys, so there was a lot of stress being put on the use of this

alloy and it probably will play a very important part in

DOE's analysis.

CHAIRMAN JACKSON: Commissioner Diaz.

COMMISSIONER DIAZ: Just out of curiosity, has anybody been trying to look at single crystal alloys at all because of their tremendous resistance to corrosion and diffusion?

DR. WYMER: No. As far as I know, that has not taken place. Of course, that would be a mighty big single crystal but --

COMMISSIONER DIAZ: I have seen them big enough in Russia. They do make them big.

DR. WYMER: No, that has not -- that wasn't brought up and we're not aware of anything.

COMMISSIONER DIAZ: Interesting. There is a program from STIO that gives a nickel alloy, single crystal alloys, as being done now, last four, five years.

DR. WYMER: I know that single crystals are sometimes much more resistent to corrosion.

COMMISSIONER DIAZ: Much more -- and they're trying to put them in jet engines.

DR. WYMER: Even with the microcrystalline materials the corrosion resistance is high for this material. It is based primarily on the existence of an oxide layer because this alloy like all other metals --

COMMISSIONER DIAZ: Right, right --

DR. WYMER: -- most other metals is not --

COMMISSIONER DIAZ: And there would be no diffusion and so it is a tremendous advantage.

DR. WYMER: Despite the fact that this looks very good, one or two of the corrosion experts raised concerns having to do with localized or crevice corrosion that might occur when you get -- by evaporation concentrations of chloride iodine and other kinds of things that enhance corrosion.

One of the speakers brought up a very interesting observation which deserves to be proven or disproven. That is, he said that there is for C-22 a temperature regime during which corrosion can occur. Above that temperature and below a temperature it is practically nonexistent. I mean the corrosion is very low, which suggests that by judicious arrangement of conditions you can avoid that temperature regime for long periods of -- to exist for long periods of time and thereby greatly enhance the lifetime of the material.

So that they're knocked down or verified.

CHAIRMAN JACKSON: Yes.

COMMISSIONER McGAFFIGAN: How quickly can you knock down or verify that? Is it relevant to licensing of Yucca Mountain, or is it a 20-year research project?

DR. WYMER: I can't answer that question

authoritatively, but my feeling is though that you could certainly ferret out a major difference between being in the temperature regime and being out of the temperature regime in a fairly short period of time.

COMMISSIONER McGAFFIGAN: Where is the temperature regime where corrosion may occur according to this?

DR. WYMER: It's fairly low.

DR. HORNBERGER: It's 100 to 120 C.

DR. WYMER: Maybe 80 to 120 or something like

that. It's fairly low.

COMMISSIONER DIAZ: I'm sorry I'm smiling. We were working at 1,400 degrees Kelvin.

DR. HORNBERGER: Well, it won't get quite that hot.

DR. GARRICK: At a little different time constant.

COMMISSIONER McGAFFIGAN: Could I also -- if 80 to 120 degrees centigrade is where the risk range is, is it easy to -- I mean, presumably you wouldn't want to be above that, that would be difficult to control, or maybe that is where you end up, if there's a lot of heat in the mountain maybe you end up above 120 and never have to worry about coming below it. But how -- which way were you going to try to control?

DR. WYMER: One of the -- I don't know, but one of the considerations is that if these alloys are as good as

they are claimed to be, then even in the corrosion regime they may well be stable for times long enough that high temperatures due to the decay heat are not important anymore, in which case you might drop down below that. So that's one consideration.

We need to know more about this particular point, because it is apparently important.

Another point was brought up with respect to corrosion of the outer layer. The C-22 is a thin inner protective layer in the waste package. There's a much thicker outer iron or steel layer which is really the main container for the waste. And that will corrode.

One of the experts brought up the fact that well, suppose you get a hole in that container and it rusts and the rust is on the inside rather than the outside, there's a volumetric change as you go from the metal to the oxide, and it'll expand and crush what's inside. And it may in fact bend, break, fracture, and some other ways do harm to the inner container, C-22 or whatever it is, whatever's chosen. And that has not been addressed in detail.

Also, the effect, when this happens, when you get iron oxidation, the effect of ferric ion on corrosion is the important factor.

Then one of the experts brought up the issue of weld integrity. He says we've got to have a couple miles of

welds there, and nobody really knows much about corrosion of welds. They know a lot about corrosion of massive materials, but welds are a horse of another color, and they always behave differently from the bulk material.

Am I overrunning my time?

CHAIRMAN JACKSON: No. Go ahead.

DR. WYMER: So the point was brought up that it's important to pay attention to some of these more practical aspects like weld integrity and their impacts on long-term performance of the waste package, waste canisters.

Then the whole issue of backfills is an important one. You can control ingressive water with backfills to a certain extent. You can control chemistry in the repository by using certain kinds of backfills having reducing properties or chemical properties to retain elements that might otherwise transport rapidly out of the container.

And then finally some of the experts question the use of taking credit for the fuel cladding, the Zircaloy cladding on the fuel as part of what you rely on to prevent release of the fission products, and indeed we said well, we're still thinking about that. We're not sure.

CHAIRMAN JACKSON: Doesn't that also put constraints relative to whether damaged fuel could go into a repository?

DR. WYMER: Sure, it does. Sure.

CHAIRMAN JACKSON: Because that issue has come up particularly since the repository is, you know, it's primarily for commercial fuel, and the issue is there, but also for other spent fuel.

DR. WYMER: Sure.

CHAIRMAN JACKSON: And then the issue of the condition of the fuel, which includes its cladding comes into play.

DR. WYMER: That's right.

CHAIRMAN JACKSON: And the impact on the overall.

DR. WYMER: Yes. Bending or cracking or any of these things is important. Yes.

CHAIRMAN JACKSON: Okay.

DR. WYMER: Then the final point was -- area that was discussed was the release of fission products and actinides from the fuel itself and the transport of those materials, and one of the invited experts particularly pointed out the fact that when you let the water reach the fuel and the water is saturated with oxygen, as it will be under normal conditions, then you're going to get oxidation of the UO2 to some higher oxide, and also the radionuclides, of which there'll be about 3 or 4 percent in that fuel, can also -- some of those also can oxidize, depending on what they are. Because normally they'll be in an oxidation state governed by the fact that they were born in UO2 and there

was that much oxygen available and no more.

So the formation of these oxidation products could in fact affect the release rates of the fission products and actinides and therefore the source term ultimately for the dose.

And finally there was the issue of secondary phases and of colloid formation. The secondary phases is not exactly the same as the formation of oxides. In this case they were talking about specific stable long-term stable secondary phases that would incorporate inefficient products or actinides within their structure. And this could dramatically change their release of fission products, actinides, but not much is known about that, and there is no good thermodynamic data base to use as a basis for calculating what the stable phases might be.

And finally colloids and pseudocolloids are I think clearly going to be of importance, and that was discussed at some length. A colloid is something like a plutonium polymer. A pseudocolloid is something like clay or iron which forms a colloid which then absorbs physically or chemically a fission product or an actinide, which then would move the way the colloid moves rather than as the way an ion in that material would move. And we felt that attention needed to be paid to those kinds of things because they could have a dramatic effect, the secondary phases, for

retarding movement, colloids for enhancing movement.

And then we thought that we wanted to know more about -- and I'm sure more is known, but we don't know it -- more about the rank ordering of the importance of these various barriers to movement in the repository one with respect to another so that we know what's the 800-pound

gorilla and what we don't care about.

CHAIRMAN JACKSON: Sure.

COMMISSIONER McGAFFIGAN: A fairly fundamental question comes from this presentation and our presentation by the staff a few weeks ago about performance assessment in this area, and that is how much of a grip are we going to have on these engineered-barrier issues by the time we're licensing, and will a conservative licensing process with an array of expert opinion have to ultimately perhaps not guess that the C-22 is going to be quite as good as claimed, and how do we -- how is this all going to come down. The staff seems to have -- and I don't have the exact transcript of the meeting in front of me -- but some real concerns about overemphasis on engineered barriers at the current time in some of the DOE work. So I wonder if that's shared.

DR. WYMER: Why don't you, John?

COMMISSIONER McGAFFIGAN: Well, either one of you.

DR. WYMER: I'll take his lead.

DR. GARRICK: Well, it is a difficult problem.

But I recall the same anxieties when we first started looking at the reactors in terms of the contribution of mitigating systems, that there was great skepticism about our ability to be able to quantify, for example, the worth of a containment system or a high pressure injection system, and much progress was made on that in a relatively short period of time.

And I think when we started focusing on that, and we started dealing with the question of what is the real worth of containment, for example, because that was a classic, similar argument, that we don't know how much the containment -- we can design it to certain pressures and we can make it robust. But it wasn't too long before we were able to put some quantification to the whole process and suggest that for some containments, the capacities of those containments were anywhere from 1-1/2 to 4 times their design basis. And it was an extremely important breakthrough to get -- to begin to get those kinds of feels and senses of what the defense mechanisms were.

I think the same is true here. I think that right now it is new territory. It is a different problem. It is -- the processes involve extremely long time constants. They are serial for the most part, rather than parallel. They are passive for the most part, rather than active. But I am confident that if we just stop worrying about it and

start focusing on dealing with the question of how much value are we getting from a drip shield or backfill, or an outer barrier, 100 millimeters of steel versus 50, or 50 millimeters of C-22 versus 20, I think we can -- I think we will be surprised.

There has been a lot of advancements made in what I would call structural mechanics from a probabilistic perspective and I am more confident than most people.

COMMISSIONER McGAFFIGAN: Could I follow-up? You mentioned the word time constants, and one of the issues -- I mean if you take -- if, hypothetically, we are working with a 10,000 year period, which is what we worked with, and that may not -- there are longer periods. One can consider the Academy talked about longer periods.

But one of the problems with these time constants is you can -- if you really believe the analysis for 10,000 years, you sort of -- everything is nice and tightly contained right there at the site, and there is no -- there

is no source term going very far. And how robust that judgment is is going to be the heart of the licensing process, if, indeed, there is a lot of emphasis on the engineered barrier.

But at some point these things break and we will have to look at what happens once the geologic system is providing the containment.

55

DR. GARRICK: Right.

COMMISSIONER McGAFFIGAN: And how things go. But to some degree, because of the time constants, you can get into a situation where, if 10,000 years is the licensing period, is the period for analysis and deciding whether to grant a license, the problem gets defined away, and then it just pops up at 60 or a 100 or --

DR. GARRICK: The compliance problem gets defined away, but the risk problem does not.

COMMISSIONER McGAFFIGAN: Right.

DR. GARRICK: Right.

DR. WYMER: Well, I would like to throw in my two cents on that. We can identify, and I have, a half a dozen areas of potential concern and things that deal with the adequacy of engineered barriers. But it is very possible, I think likely, that by not particularly sophisticated analyses, quite a few of these things will be laid to rest as being below the horizon, and there will only be a few that will stand out as peaks that we really -- that really deserve attention. And that's why we make the point that this rank ordering is -- early on, is important, because those things which even on a semi-quantitative or almost qualitative basis, you can rule out, reduce the field substantially, or on the basis of the fact that DOE is not even going to rely on those things in the first place.

56

So it seems to me that there is a -- we are just before making a major simplification in what we need to be concerned with. And if attention is paid to these, some of these issues that we have raised here, they can -- some of these will just be thrown aside and they won't even turn out to be important.

COMMISSIONER McGAFFIGAN: One last question. Whose job is it to bring about that major simplification? I mean you are recommending it. But is that DOE's job to bring it about?

DR. WYMER: It's DOE's job to recommend it. It is NRC's to be sure that they are good recommendations.

DR. GARRICK: Speaking of recommendations, as you know, this particular work is work in progress, and we intend to send you a letter and to make some recommendations.

CHAIRMAN JACKSON: Okay. Dr. Garrick.

DR. GARRICK: It's an interesting dichotomy. The essence of reactor safety is the presence of water. The essence of repository safety is the absence of water. You would think we could get it right somehow.

CHAIRMAN JACKSON: Well, the presence of water can also be a problem.

DR. GARRICK: Well, in some reactors, a special problem.

57

CHAIRMAN JACKSON: That's right.

DR. GARRICK: And under some temperature conditions.

I want to talk a little bit about planning. Planning is something you kind of really hate to do. But when you have done it, --

CHAIRMAN JACKSON: Oh, darn.

DR. GARRICK: -- you are really glad you did it. That's the case.

CHAIRMAN JACKSON: Good. Because it is over or because --

[Laughter.]

DR. GARRICK: Well, partly because of your leadership, we have moved in the direction of trying to become much more formal in our planning. The ACNW has always attempted to prioritize and plan its activities for the forward year and years. But it was -- this year was the first time we attempted to get a little more structure and a little more formal in the whole process.

We tried to lay down some rules that were the basis for our planning activity. We wanted to be darn sure that we didn't get ourselves so tied down to our plan that we were not in a position to offer advice as a result of some major changes and we did not want to get in a position that we couldn't respond quickly to change. So we had that

as one of our major commitments and rules for the planning process.

The one thing that does come from a plan is the ability to kind of look at yourself and measure against some sort of a baseline, and we have been doing that. We have established the plan as input to our operating plan. And, of course, our operating plan has such metrics in it as timeliness of our information, its quality, its efficiency, its effectiveness, et cetera.

Also, we, in this year, in a little more formal manner, completed a performance evaluation of ourselves. That was documented in a SECY document on June 1st. The status of our planning activity is that we were extremely pleased that the Commission also read that letter and responded directly to us, and those comments are very helpful and have to do with the fact that perhaps our planning was a little too narrow in scope, maybe it didn't match up with all of the elements of our charter, and we intend to take those comments as source material for the planning activity that we will engage in later this year.

We have received Commission requests for new work as a result of exposing the plan. For example, in the low-level waste area, the issue that has already been brought up this morning of criticality at Envirocare and a generic consideration of criticality in low-level waste

sites is something we are currently addressing.

We have, certainly, been addressing the issue of risk. The comment was made to get outside of the box, if you wish, and look at some topical issues like reactor vessel handling and what to do about used reactor vessels. The Trojan reactor vessel has been mentioned in particular.

And, of course, clearance levels are another example of things that have been mentioned that we maybe ought to be prepared to deal with. And, of course, we have to be cautious about managing our scope because we have resource limitations just like everybody else. And in regard to that, there was a memorandum to the Chief Financial Officer concerning additional resources for fiscal year 1999 to give us increased confidence that we can, indeed, respond to these requirements.

The Committee is very pleased to report that we have issued letters on all of our first tier priority topics. The first tier priority topics included such issues as viability assessment and site characterization, risk-informed, performance-based issues, engineered barrier systems, decommissioning and research.

In kind of the spirit of accomplishments, we provided recommendations and advice on a rather large number of issues such as defense-in-depth. We wrote you a letter in October of last year. Multiple barriers in March of this

year. The use of PRA in the waste field, this was the issue of what lessons can we carry from the vast amount of experience in the reactor field to the waste field, and we wrote a letter on that. And on the subject of the effects low-level ionizing radiation, prompted by Commissioner Diaz, and we wrote a letter on that.

One of the things that the Committee has been relatively sensitive to and quite active in is trying to heighten the awareness and the need for attention to the engineered barrier system issue in high-level waste disposal and the growing apparent dependence on engineered systems in -- being in the demonstration of the performance of the repository, and we have been very active in addressing that issue.

One of the highlights of the year and, certainly, one of the most technically stimulating activities we have engaged in in the last couple of years was the working group that Ray Wymer was the lead person on, that we had in early June, and we think that working group activity generated some extremely valuable source material for us to address much more intelligently the issues surrounding increased dependence on engineered barrier systems.

One of the things that the Commission has reminded us to do from time to time is to be aware of international activities in our work and in our gathering of source

material as a basis for our advice. We have done a number of things in direct response to that. One of the things we certainly are pleased that happened is that we got a member of the Committee, namely, Dr. Fairhurst, who has a vast amount of international experience and seems to know everybody in this business, and that has been extremely helpful in organizing a number of things, including a trip that we -- and a meeting we expect to have with the German RSK later this year.

Future activities, we expect to issue to you a major letter report on engineered barrier systems. We also expect to issue letters on such topics as post-disposal criticality, the NUREG, 10 CFR Part 63, total system sensitivity analysis. In fact, we have completed that letter at this meeting.

The interesting issue of importance measures and the whole question of can you really do importance measures for systems typical of repositories. The issue of decommissioning. And, of course, we expect to send you some advice on the viability assessment.

CHAIRMAN JACKSON: Commissioner McGaffigan.

COMMISSIONER McGAFFIGAN: Could I ask one question on the post-disposal criticality issue? I know you got briefed on this yesterday, and I understand you asked some penetrating questions. If you go back to your risk-informed

definition of risk, the triplet model of risk, we have got something there that is vanishingly small, although we could, I guess, try to quantify it, and you questioned, and I think appropriately, trying to quantify vanishingly small.

The consequences from the Oak Ridge study, even if it happens, are not enormous. And so the question, from a regulator's perspective, and the reason you have been asked the question, obviously, is we -- the Commission is asking is it -- When is enough, enough?

DR. GARRICK: Yes.

COMMISSIONER McGAFFIGAN: Do you have -- not trying to get the letter report out of your mouth right this moment, but do you have an initial impressions as to when enough is enough in this area?

DR. GARRICK: Well, I do. I think this is an ideal example of what we were talking about earlier, of an analysis that should be risk-informed. Even though, to do it quickly, we may be faced with a lot of uncertainties, I suspect we still would learn a great deal about it. We are going to probably encourage that kind of an approach be taken. We are not very sympathetic to an extensive research activity based on what we have heard so far.

COMMISSIONER McGAFFIGAN: Okay. Thank you.

DR. GARRICK: We have mentioned the issue of international technical meetings. Dr. Fairhurst continues

to do that and be our ambassador, but we will enhance that a little bit and see what he is up to when we all go to Germany.

We expect to hold a stakeholders meeting in Yucca Mountain vicinity to enhance public participation. You recall that that is one of our goals, is to offer advice on how to enhance public participation. And we expect, finally, to conduct increasingly comprehensive self-assessments.

COMMISSIONER DIAZ: Excuse me. A few moments ago you mentioned that you have already reviewed or considered, or read about the clearance of materials and the potential development of a rule. Are you prepared to engage in this issue of the clearance of materials? You don't mention in your future activities.

DR. GARRICK: We are prepared to engage. I think that's what advice committees are prepared to do.

COMMISSIONER DIAZ: That's good.

DR. GARRICK: It is not a comfortable issue and a lot of people would just as soon that we not engage, but we will. We will engage.

COMMISSIONER DIAZ: All right.

DR. GARRICK: I think that completes our discussion. We are sorry we ran over a little bit, I guess.

CHAIRMAN JACKSON: Okay. That's all right.

COMMISSIONER McGAFFIGAN: My only comment is I think next time they are going to have him do risk-informed, performance-based at the end of the agenda rather than the beginning.

[Laughter.]

CHAIRMAN JACKSON: No, I told them they would have all the time they needed. You had all the time you needed.

DR. HORNBERGER: Yes, we did.

CHAIRMAN JACKSON: Well, let me just say that the Advisory Committee's views on the matters you addressed today are of tremendous value and importance to the Commission as we are trying to deal with the complexities of

a number of technical and policy issues.

You talked about risk-informed and performance-based regulation, which you know is an important area.

DR. GARRICK: Yes.

CHAIRMAN JACKSON: On the issues associated with licensing activities for high-level waste repository, decommissioning, which is becoming increasingly important, and other materials-related areas.

I want to commend you for the high quality of today's briefing and of the work you do, and just to tell you that the Commission does appreciate your efforts.

And so, unless there is any further discussion,

this meeting is adjourned.

DR. GARRICK: Thank you. Thank you very much.

[Whereupon, at 3:16 p.m., the meeting was concluded.]