Official Transcript of Proceedings

NUCLEAR REGULATORY COMMISSION

Title: Advisory Committee on Reactor Safeguards
Future Plant Designs Subcommittee

Docket Number: (not applicable)

Location: Rockville, Maryland

Date: Thursday, June 24, 2004

Work Order No.: NRC-1558 Pages 1-272

NEAL R. GROSS AND CO., INC.
Court Reporters and Transcribers
1323 Rhode Island Avenue, N.W.
Washington, D.C. 20005
(202) 234-4433

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

+ + + + +

MEETING

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

(ACRS)

SUBCOMMITTEE ON FUTURE PLANT DESIGNS

+ + + + +

THURSDAY,

JUNE 24, 2004

+ + + + +

ROCKVILLE, MARYLAND

+ + + + +

The Subcommittee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B3, 11545 Rockville Pike, at 1:00 p.m.., Thomas S. Kress, Chairman, presiding.

COMMITTEE MEMBERS:

THOMAS S. KRESS, Chairman

VICTOR H. RANSOM, Member

STEPHEN L. ROSEN, Member

WILLIAM J. SHACK, Member

GRAHAM B. WALLIS, Member

ACRS STAFF PRESENT:

MEDHAT EL-ZEFTAWY

ALSO PRESENT:

DENNIS BLEY, Buttonwood Consulting

MARY DROUIN, NRC

TOM KING, NRC

JOHN LEHNER, Brookhaven National Laboratory

VINOD MUBAYI, Brookhaven National Laboratory

AMARJIT SINGH, NRC

A-G-E-N-D-A

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

1:10 p.m.

CHAIRMAN KRESS: The Advisory Committee on Reactor Safeguards Subcommittee on Future Plant Designs. I am Thomas Kress, Chairman of this Subcommittee.

Members in attendance are Vic Ransom, Steve Rosen, William Shack and Graham Wallis.

The purpose of this meeting is to discuss the NRC staff's proposed draft technology-neutral framework document for new plant licensing. The Subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions, as appropriate, for deliberation by the full Committee.

Dr. Med El-Zeftawy is the Designated Federal Official for this meeting.

The rules for participation in today's meeting have been announced as part of the notice of this meeting previously published in the *Federal Register* on June 14, 2004.

A transcript of the meeting is being kept and will be made available as stated in the *Federal Register* notice.

It is requested that speakers first

identify themselves and speak with such sufficient clarity and volume so that they can be readily heard. What really that means is please use the microphone.

We have received no written comments or requests for time to make oral statements from any members of the public regarding today's meeting.

I'm pleased to welcome the staff again on what I consider very important piece of work. And I consider this another one of these interactive meeting where we try to give you our thoughts and hear what you're doing, and don't expect any letters or anything like that, but try to give you some feedback at this early time.

So with that, I'll turn it over to -- Mary, you going to lead us off?

MS. DROUIN: Thank you.

We're very pleased to be here. Long overdue, because I think our last time on this topic was back last fall sometime, and we've done a lot of work since them. But before we get started, I'd like to introduce myself as Mary Drouin. And the team with me here to my right is Dennis Bley from Buttonwood Consulting. And we have Tom King from NRC, Vinod Mubayi and John Lehner from Brookhaven.

And Jit Singh over on the side table. NRC is part of the small core team, but we have a lot of other people who have provided us with tremendous help.

I'd also like to recognize Jerry Wilson from NRR. Karl Fleming is part of the team. Marty Stutzke from NRR has provided us with a lot. I don't think I could go through and list everyone, but a lot of great thoughts from great people have--

CHAIRMAN KRESS: What do you guys do? Sit around in a meeting room and bounce ideas off of each other.

MS. DROUIN: Actually we do that quite a bit. We bring the whole team together on a very frequent basis and --

CHAIRMAN KRESS: You got a certain set of issues you got to deal with and bounce them around?

MS. DROUIN: Yes. And, you know, before the meetings we'll ask everybody to give it their thoughts and bring them to the table. And so you really truly see a team view here. This is not the thinking of any single of any single person. Many people.

CHAIRMAN KRESS: Who ends up writing the actual stuff in the document?

MS. DROUIN: Everybody.

CHAIRMAN KRESS: Everybody.

MS. DROUIN: And that's pretty much what you're going to see today. It's a team effort, and I can't stress that enough. But, you know, a team can't write a document.

CHAIRMAN KRESS: Oh, I know. That's right.

MS. DROUIN: So everybody has kind of a ownership of a different chapter. They're responsible for bringing all the views together and trying to put it down on paper where it's, hopefully, understandable. And that's kind of what you're going to see today. You know, the people who are doing the speaking have been the leads on the writing of that, which means I don't have to do a lot of talking because I don't do a lot of the writing. I just review it.

CHAIRMAN KRESS: I've been there.

MS. DROUIN: Okay. Well, there you go.

DR. SHACK: I see your advanced PowerPoint engineering is really moving ahead full speed, too.

MS. DROUIN: You see there the agenda. We're going to try and walk through each of the chapters in detail.

I hope it's okay if I'm pretty aggressive with trying to keep us on schedule because there's a lot in each of these chapters and I'd hate for us to get bogged down. Any one of these chapters we could spend days on.

CHAIRMAN KRESS: Well, I must admit I have a lot of thoughts and comments, so you may get interrupted. But we'll try to not keep you too long.

MS. DROUIN: And I'd hate for the date to get by and, for example, we haven't gotten to chapter five, for example and gotten through chapter 4. Because, as I said, I think we could spend hours.

CHAIRMAN KRESS: We'll do our best. But, you know, we do have a lot of comments.

MS. DROUIN: Yes.

Our purpose today, I'm going to try and get through these preliminary things pretty quick -- I wonder what happened to our purpose slide.

CHAIRMAN KRESS: Yes, we've got a purpose slide here. It came before that.

MS. DROUIN: Okay. There we go.

We're trying to show, you know, what we've today. And, as I've said, it's been a long time since we've been here. Last time we were here everything was very much at a very high level of conceptual. And now we've kind of taken the concepts and flush them out and put some meat behind them and detail. We're at the point where we feel like we're ready to really share some of these details with the public.

CHAIRMAN KRESS: How do you go about doing that?

MS. DROUIN: I'm sorry?

CHAIRMAN KRESS: How will you go about sharing the details? I mean, it's not like exactly a rulemaking yet for a long time.

MS. DROUIN: We have scheduled a public meeting. We're getting ready to put out the public notice. We're going to have a public workshop.

CHAIRMAN KRESS: It would be a workshop?

MS. DROUIN: At the end of July a two day workshop where we plan to walk the public through what we have here.

CHAIRMAN KRESS: I'd like to go to that.

MS. DROUIN: And we're going to try and put some information prior to the public workshop on the website. You know, at least these viewgraphs, which will be similar to what we will be showing at the public workshop. And how we modified them. We plan to put those public before the workshop.

But the biggest question --

CHAIRMAN KRESS: I've been reminded that one of our new process elements is that we're not supposed to interrupt you for the first ten minutes.

DR. SHACK: They didn't tell us what the conclusion were, which negates the rule.

CHAIRMAN KRESS: Oh, yes. That's right. So we're even.

MS. DROUIN: Okay. I'm not sure what all that meant.

MR. ROSEN: So the ten minute misconduct penalty has been withdrawn.

MS. DROUIN: Oh, okay.

MR. ROSEN: But we'll still try to give you ten minutes.

MS. DROUIN: That last bullet to me is a very important bullet, because I have to say every time I read this document, and we were just talking about in our team meeting this morning, I'll come across a paragraph and I'll have to read that paragraph three or four times to remember what were we talking about; which tells me we need about two pages of extra writing to really explain. There'll be something very fundamental --

DR. WALLIS: Maybe you need less.

CHAIRMAN KRESS: Yes.

DR. WALLIS: Maybe you need clearer writing but less.

MS. DROUIN: It some cases, it might be that.

DR. WALLIS: If you have to read it many times to figure out what it means.

MS. DROUIN: It could be that.

So that's one of the things we're really asking for where have we not been clear, where the idea of what we're trying to convey either it's not explained well enough or it needs more explanation, less explanation, whatever to pinpoint that.

I think we're at the point in many places with we the team are so close to this we're not seeing a lot of these problems.

We're going to walk through each of the chapters.

Just background real quick. You know, when you look at Part 50 and where we are with this agency over the last 30-40 years, it's very much been concentrated and focused on light water reactor technology and knowledge. And as we move into the future with these new reactors, new designs, particularly as we start trying to bring more and more risk insights into the decision making process and trying to make ourselves more effective and efficient, it sort of begs for a new framework to take the lessons from the past and see how we can, perhaps, restructure a new regulatory structure.

MR. ROSEN: The agency licensed Fort St. Vrain, right?

MS. DROUIN: Yes.

DR. SHACK: Case-by-case.

MR. ROSEN: They're not entirely new.

CHAIRMAN KRESS: Yes, but they had to use a crowbar and bend things around.

MS. DROUIN: We're not saying it can't be done, we're just saying to be more effective and efficient, you know a new regulatory structure could help in that area. And that's what we're striving to do.

When you look at SECY-03-0047, that went forward. It did identify 7 policy issues for non light water reactors. And these policy issues, we did say in that paper, we were going to try to address the resolution of them in this framework document. So some of those we'll be getting into that, and you'll see some of that as we go through the document.

We'll try and keep our terminology, hopefully, consistent and clean. And what I mean by that is, you know, we use this word framework all the over place unfortunately to mean different things. What we have here, what I refer to as the regulatory structure for the licensing of new reactors. And that what we're calling a structure. And part of that structure has four tasks associated with it.

DR. WALLIS: Well, I had a suggestion with this. It seemed to me that framework is something you construct in order to do the job. And there's something you start with before that, which is your principles and objectives, which is something different form the framework. You've put them into the framework themselves. You've put the QHOs and those things into your discussion of the framework itself. But I think something should stand above that to start with, which is your definition of public health and safety and the objectives and so on that the frameworks has to satisfy. And then the framework is more the structure that you have created in order to meet those objectives.

Just a suggestion, that's all.

And I thought there were two different ideas in the framework.

MS. DROUIN: That is one way to look at it. I'm just explaining how we are using these terms.

DR. WALLIS: I know, but I was making a suggestion about how you might separate that.

MS. DROUIN: And I understand.

DR. WALLIS: Something which is so universal.

MS. DROUIN: Right.

DR. WALLIS: This particular framework--

MS. DROUIN: And I mean we will look into that, but just to get through today's purpose in explaining --

DR. WALLIS: Yes, I know.

MS. DROUIN: -- I'm just trying to put you in context of how we've used it. That's not to say we can't come back and take your suggestion, and we will.

CHAIRMAN KRESS: Well, that all depends on what your view of a framework is. I mean, framework could very well include those things like you did.

MS. DROUIN: Right.

MR. ROSEN: Now you see, I have a question about this whole chart. When you set out to do this it was to establish a technology neutral framework, and you do that in task 1, 2 and perhaps the enabled task on the right called "Technology-Neutral Regulations." But then you add a whole another layer in tasks 3 and 4 where you now move into making that technology-neutral framework into technology specific. And I would have thought that we were going to be here about the top three blocks, not the bottom two. And maybe you need to recast what you're trying to do.

MS. DROUIN: That's what I'm trying to explain here. From the beginning our effort or our program was to create this regulatory structure for the licensing of new reactors. And when you go back to the advanced research plan, that's what we were doing.

To accomplish that we identified four things to create this new regulatory structure. And this is what we've shown here.

The first one was to create this technology-neutral framework. And the technology-neutral framework was to come up with guidelines and criteria such that when you implement them, you would ultimately -- see now where's the problem when you use a computer versus a transparency. I can't point.

MR. ROSEN: Yes, you can. Just use your mouse.

MS. DROUIN: Oh. Cool.

DR. SHACK: Just don't click.

MS. DROUIN: So this whole picture is the regulatory structure. And so the first part is to create this framework --

DR. WALLIS: What is it trying to do?

MR. ROSEN: It's the first bullet. That's your point and I think it's a good one.

DR. WALLIS: What is it trying to do?

MR. ROSEN: It's a good one. It's that first bullet, to development and implement a regulatory structure for the licensing of new reactors. Not a technology-neutral thing, a regulatory structure. Then -- and that ought to be on this page all by itself.

MS. DROUIN: That's what it's going to be, it's the overall objective is to create this.

MR. ROSEN: And then to do that we're

going to have a technology-neutral framework which will allow us to create technology-specific framework. I mean, to branch off that. It's just a way of presentation that's clearer.

MS. DROUIN: I mean all I'm saying to say is that this whole structure is this whole figure. And there's different parts to the figure, and the first part is creating this technology-neutral framework. The second part is we're going to apply the framework to come up with proposed technology-neutral requirements. The next part of it is to come with what we call our technology-specific framework, which is going to show how to take these two and apply them --

MR. ROSEN: But, Mary, the problem is that you don't have a licensee. If you don't have an applicant, you can still do 1 and 2 and the one on the right that's not labeled. But you have to have a licensee or an applicant to do 3 and 4. He has to come in, say, I want to build a molten salt reactor or something.

So these things are of a different character and yet you've got them pushed together.

MS. DROUIN: You don't need an application to do task 3 in our opinion, but that's a discussion for another day.

MR. ROSEN: If it's technology-specific, you have to know what technology it is.

MS. DROUIN: No. Task 3 is to how do you apply it on the technology-specific. The application of it is task 4.

CHAIRMAN KRESS: One would have to have it.

MS. DROUIN: On task 4, ideally you wouldn't do task 4 unless you had an applicant.

DR. WALLIS: Well I think we can move on because you're not really --

MS. DROUIN: All we're talking about today is task 1.

CHAIRMAN KRESS: Yes, I think so. Yes, I think we've agreed these are good things to do.

DR. WALLIS: Yes. It's only the top part you're going to talk about anyway.

MS. DROUIN: Right. And that's all I wanted to say on that figure.

So today we're concentrating on this first one, which is to develop a technology-neutral framework. And the thing that we really point out is that this is guidance and criteria to the staff.

DR. WALLIS: But you need something

before that, which is there for the public, too, which is what are your over arching principles to be used or something. And then you get into the details of what does the staff need and what does the licensee need and so on. You need an over arching statement of purposes and measures of success or something, it seems to me.

I know the staff needs this, but it's got a broader audience than that.

CHAIRMAN KRESS: That may be something you could think about later. I don't think --

MS. DROUIN: Well, we have that in here.

CHAIRMAN KRESS: Yes. I don't think it detracts from what we're really doing.

DR. WALLIS: As long as it's mixed up with other stuff. Yes. Okay.

DR. SHACK: Again, I agree with Graham. I really think these criteria are something that, you know, we all have to buy into.

DR. WALLIS: Right. Right.

DR. SHACK: You know, everybody has to agree that these are the right criteria, not just the staff.

MS. DROUIN: Right, but it's still guidance to the staff.

DR. WALLIS: Well, that comes later after you've agreed on these other things.

MS. DROUIN: That the framework, it's not guidance to the licensee to go use this; it's guidance to us --

DR. SHACK: To craft some regulations.

MS. DROUIN: -- to craft regulations. Now, absolutely you know you'd want buy-in from all your stakeholders.

DR. WALLIS: I think it's more than this.

MS. DROUIN: It's ultimately buy-in to the stake.

DR. WALLIS: I think part of this could be published *The New York Times*.

DR. SHACK: And it will be.

DR. WALLIS: And it will be, right.

MS. DROUIN: I'm going to skip this one because it gets right into.

DR. WALLIS: Even the *Washington Post* might print it.

MS. DROUIN: We call them, in answer to your question, Graham, desired characteristics.

DR. WALLIS: Yes, that's getting a bit to it, but that's in more detail than I was thinking of. Yes. These are what I call specifications, but that's okay. Design specifications.

MS. DROUIN: I guess I would have called them another words, but it's trying to say okay, we're going to build this framework.

DR. WALLIS: Yes.

MS. DROUIN: And the framework is to ultimately when you implement it give you the criterion guidelines for constructing these technology-neutral regulations. And how do we know the framework --

DR. WALLIS: Yes, but eventually the real purpose is to assure the safety of these future reactors, isn't it? I mean, you're down to a great deal of level of detail here.

MS. DROUIN: I think these things are still a high level in the fact that we'd like for the framework to be traceable.

DR. WALLIS: Well, I agree with all those things. I think those are good.

MS. DROUIN: You know, we want it to be defensible.

DR. WALLIS: Those things are good.

MS. DROUIN: I think these things at a high level very critical because when you look at

Part 50 --

DR. WALLIS: I anted to buy an automobile, it has to have these kinds of characteristics, but what's the automobile for? Whose going to buy it? Some big picture, that's all.

MS. DROUIN: I think we're going to tog et there for you.

DR. WALLIS: Okay.

MS. DROUIN: But I think overall you want some ground rules --

DR. WALLIS: Of course.

MS. DROUIN: -- of how you're going to construct this. And I'm saying here the ones that we've laid out.

DR. WALLIS: Yes.

MR. ROSEN: Rules first: objective of the game second.

MS. DROUIN: I mean, you can flip them.

CHAIRMAN KRESS: It doesn't have to be linear thinking.

DR. WALLIS: Cart before the horse.

MS. DROUIN: Okay. I think we could probably skip the next one two. That's just to read showing you how we'll organize it in terms of our documentation. So let's just get right into our overall --

CHAIRMAN KRESS: That is an overall.

DR. WALLIS: So there you are, there's a top level, there you are getting there at the very top there, yes.

MS. DROUIN: But I just kind of wanted to walk you through how the program is structured. Now we're getting right into the framework. And overall is to me the Atomic Energy Act, the protection of the public health and safety, which is what we show in this top blue box here.

DR. WALLIS: Which has specific measures which are, presumably, the QHOs, right? That's your starting point is the QHOs, I think.

MS. DROUIN: Well, our starting point is the Atomic Energy Act.

CHAIRMAN KRESS: The Act itself has the words of "security" in it You're going to worry about that later, I guess.

MS. DROUIN: I'm going to get into that.

CHAIRMAN KRESS: Okay.

MS. DROUIN: Be patient.

MR. ROSEN: No, no, no. Not something we're good at.

MS. DROUIN: Yes, we're seeing that today.

We'll start with the Atomic Energy Act. And from the Atomic Energy Act of protecting public health and safety. We're saying that in order to do that we want to look at worker risk, we want to look at our offsite population and we want to look at the environment. And then coming from that we've laid out two complimentary parallel integrative approaches.

DR. WALLIS: But without something like the QHOs, you have no measure of what you're doing in that first box.

CHAIRMAN KRESS: But you go down to the second box.

MS. DROUIN: It comes into the second one. I'm going to get to it.

DR. WALLIS: No, it doesn't. It's right up there at the top.

MS. DROUIN: That's our overall --

DR. WALLIS: However you want to protect, you've got certain measure of what you call public health safety and security.

MS. DROUIN: Our overall mission is to protect the public health and safety.

DR. WALLIS: Yes. So achieve the QHO, therefore, in other words.

MS. DROUIN: Now we haven't gotten to the QHOs yet.

DR. WALLIS: Well, they have nothing to do with protective strategies or any of the other stuff. They're a measure of what you're trying to do in the top box.

CHAIRMAN KRESS: Well, they got risk objectives in that green box.

DR. SHACK: Rick objectives in the green box.

DR. WALLIS: But they are surrogates.

MS. DROUIN: No, no, that's not the way we constructed this.

DR. WALLIS: Well, you think your way, but okay.

DR. SHACK: She wins this one, because the Atomic Energy Act doesn't mention the QHOs, I can guarantee that.

CHAIRMAN KRESS: Yes.

MS. DROUIN: That is a QHO.

DR. WALLIS: But you have to get something that translates this vague statement at the top into something practical.

MS. DROUIN: And that's what I'm trying to explain.

DR. WALLIS: No.

DR. SHACK: She'll get there.

DR. WALLIS: Well, I guess -- okay. You may come around to my view eventually.

MR. ROSEN: As do most of us.

This chapter 4, it seems like you have "and," an important "and" left out of the label. Should "Risk objectives and design, construction and operation objectives" it should be.

MS. DROUIN: Okay. We're going to get into details in all of these. I'm just trying to show you the overall framework, this hierarchial structure and how it all first today. And it's a top down approach. We're starting with the ATomc Energy Act. From that we're saying, okay, how are we going to show that we're going to protect the public health and safety. And we're coming down two parallels but also integrated. On the left we're saying we're going to construct these protective strategies; this is looking at it more in a deterministic way. And we're saying we're going to have these strategies and these strategies are going to be our safety fundamentals that we're going to define and implement that will help us meet our goal of protecting the public health and safety.

At the same time, we want to look at it from a risk perspective, and this is where we bring in the QHOs. And we're starting from our risk objectives and we want to meet the QHOs. And you'll see that in detail and how that's going to get broken down.

DR. SHACK: Just to quibble now. I mean, I would have made the risk objectives the level 2 and the protective strategies and the defense-in-depth would be underneath the risk objectives --

DR. WALLIS: Of course. Of course, yes.

DR. SHACK: -- is essentially is the way that you achieve those.

DR. WALLIS: Right.

DR. SHACK: It seems tome, I don't see the strategies and the objectives at this same level. I see the strategies and the defense-in-depth at the same level to achieve your objective.

MS. DROUIN: Well, what you will see is that the protective strategies are defense-in-depth the way we've constructed them.

You know, there's many different ways you could draw this and they all have advantages and disadvantages to how you try and explain something that's not two dimensional.

DR. WALLIS: You say it on slides 2, 1. You say your top down strategy starts with a desired outcome, identifies goals to achieve this income and then identifies ways to do it. Now that's what the framework should follow as well, is the words should reflect the picture, you know. Maybe you'll come around to this. I don't want to distract you, Mary.

MS. DROUIN: But we're ultimately trying to go down to --

MR. ROSEN: There's another point --

MS. DROUIN: -- chapter 6 here the technology-neutral requirements and these three boxes, the protective strategies coming up with risk objectives, coming up with design construction, operational objectives and then integrating defense-in-depth as part of that are going to then ultimately lead us to how we want to construct and write the content of these technology-neutral regulations. And these are the guideline and criteria that we're laying out are in these areas that will ultimately get us to our requirements. And we're providing guidelines in those things.

CHAIRMAN KRESS: I think we were being a

little picky on how you line these up, and I think you've got the right boxes.

MS. DROUIN: Yes. And you can show these boxes many different way.

CHAIRMAN KRESS: Yes.

MS. DROUIN: The whole thing that I think, Tom, you just said. These are the things that we have focused in on on providing guidance and criteria for.

MR. ROSEN: But this is central I think to think about it correctly. If you don't, people are going to say well they just took their old deterministic stuff and added the risk-informed stuff so they could have more requirements. And that's not what you're trying to do.

MS. DROUIN: No, and that's not what we've done.

MR. ROSEN: It's not double jeopardy, and whereas in the first wave of licensing we had single jeopardy with just the deterministic. Now people will accuse us, the regulators, of having a deterministic basis on top of which we have layered on a risk basis. No, no. That's not what you're trying to do and not what we should be doing.

So I think these comments go to the

making clear that that is not what we're trying. That the risk objectives are primary and the protective strategies are supporting for that. And I think that goes to what we've been saying. It's a very important distinction.

MR. KING: Except you have to be careful you don't come across as a risk based system either.

CHAIRMAN KRESS: That's right.

MR. KING: That's one the reasons we put protective strategies at the same levels as the risk guidelines, because they're risk-informed. And you can look at it, you know have risk guidelines but you don't want those drive everything in the sense that somebody can take --

DR. RANSOM: Well, a somewhat perspective on this, I think that is not what the Atomic Energy Act attempted to. It attempted to utilize atomic energy for the benefit of society. this is a very negative thing. You know, *The New York Times* would look at this, they'd say well the best way to accomplish your objective is don't do it. Absolutely certain.

CHAIRMAN KRESS: But I think the Act spelled out some things for the NRC to do, and i think that --

DR. RANSOM: Well, I think that's true.

CHAIRMAN KRESS: -- to my mind that captures what you guys ought to be doing. The other part is for somebody else, I think. I mean, you could drive these things out of there, the Atomic Energy objectives, as the appropriate objectives from that Act for NRC. So I think that's equivalent also.

DR. WALLIS: Well, if you're not risk based, can you at least admit to being QHO based? What else have you got to stand on?

MR. KING: Well, we've got some structural aspects to stand on, and that's what we're trying to show that would protect our strategies.

DR. WALLIS: But for what purpose.

DR. SHACK: The structural aspects in those protective strategies are really trying to reach the risk objectives. Now, I mean, if you want to interpret risk objective in terms of a specific number, you might be accused of being risk based. I mean, I mean I always look at risk objectives a larger broader context of things. An to me, you know, the deterministic one is just a way of achieving those objectives.

MS. DROUIN: But ultimately, you know, where we're going is we're going to have to write requirements. Now, you're sitting down and I'm sitting down and I'll say I'm going to say okay, I'm going to start writing requirements. What am I going to write them to? The risk objectives give me guidance to maybe the level of detail, which I want to judge myself to write against, but didn't tell me what to write. And that's what the protective strategy--

DR. SHACK: But it tells me what I want to accomplish when I do write.

MS. DROUIN: It tells you want to accomplish, but it doesn't tell you what you need to write. And the protective strategies --

DR. WALLIS: But there is no sense in writing it if you're not trying to accomplish something.

MS. DROUIN: I'm going to write requirements because if I meet these protective strategies; you know, if I write a requirement that says you shall not do or you shall do it something, well what is it I'm writing it to?

DR. WALLIS: Right.

MS. DROUIN: We'd never be able, unless

we were risk based, say you're going to write a requirement that says you have to keep your core damage frequency below 1E-4. No. And so as we write requirements for design construction and operation, what we've said is that we have defined these protective strategies and we're going to write requirements to meet those protective strategies for design construction requirement and we're going to use risk insights in helping us. We're going to have risk objectives there. So they are kind of at the same level.

DR. WALLIS: The strategies have a purpose.

MR. BLEY: I'm Dennis Bley.

If I may, what we do go on to say there and in the later chapters that their purpose is to account for the uncertainty in the risk calculations. And that in this chapter 5 down at the bottom there is a balancing of all those. You got to cover all the protective strategies, but the strength with which you cover them depends on the uncertainties about whatever particular technology you're dealing with.

So we didn't try to do it all in the first introductory chapter, but that's where we head a little later.

MR. ROSEN: But if you had perfect knowledge, you wouldn't need protective strategies.

MR. BLEY: Exactly.

MS. DROUIN: That's right.

MR. ROSEN: So putting them at the same level, see, is still troubling to me because the protective strategies are a remedy for the fact that we don't have prefect knowledge and never will because of completeness uncertainty.

MR. KING: But that's important. I mean that to me says, you know, I don't care what your PRA says, I'm going to have certain protective strategies from a structuralist standpoint, and that's all we're trying to show here.

DR. SHACK: Yes. But I think you're confusing PRA and risk. I mean, the risk objectives are really independent of the PRA. PRA is just one way we happen to be looking at risk, at least from my point. I see a much larger thing in that chapter 4 box than the PRAs. It's really everything I mean by risk.

MR. KING: Risk in a qualitative sense, I agree with you. But putting a number up above these things troubles me.

DR. WALLIS: If you have no number, you have no measure of success.

MR. KING: But you have do. You have a number over in the green box.

DR. WALLIS: No, no.

MR. KING: And you've got some structuralist things in the orange box.

DR. WALLIS: Well, if it's completely detached from the top, it's no use.

MR. KING: Well, I disagree with that.

DR. WALLIS: Okay.

MR. ROSEN: Well, I'm not arguing. I'm not arguing for a number in the box. I'm just arguing for a different relationship between these things that'll be seen as the risk objectives is what counts.

CHAIRMAN KRESS: I think we made our point on that, and you guys can consider the --

MR. BLEY: I think we've got it.

CHAIRMAN KRESS: Yes.

MS. DROUIN: Okay. Let's see if we can get past this figure.

DR. WALLIS: This is our funny figure.

CHAIRMAN KRESS: Yes. This is one we may have some comment on.

DR. WALLIS: What is that blue arrow doing there?

MS. DROUIN: Showing that you're going from hot -- your risk is decreasing. And all we're trying to show here is that in this figure you could look at your current reactors. Our current reactors are in this yellow and green region. And these are not meant to be bright lines; they're supposed to be where you have safety goal and you have adequate protection, these are meant to be very fuzzy lines.

DR. WALLIS: And those safety goals are the QHOs?

MS. DROUIN: QHOs.

DR. WALLIS: Ah-ha. Thank you very much.

CHAIRMAN KRESS: Or some F-C surrogate.

DR. WALLIS: Or some surrogate.

MS. DROUIN: Or some surrogate. And right now our current reactors are in these regions.

DR. WALLIS: Thank you very much. You're going to say new reactors are really going to meet the goals, not be sort of wishy-washily allowed to get above the goals to something we don't know about called adequate protection?

MS. DROUIN: That's what we're striving to do.

DR. WALLIS: That would be very good if you would state that clearly.

CHAIRMAN KRESS: They do say that.

MS. DROUIN: And if you look in the framework document, we even bold it and italicize those words, and we say the technology-neutral regulatory climates for new reactors --

DR. WALLIS: But then you change it. You say future reactors only a small chance that the risk extends into the tolerable region. Now you've undermined your statement, you've gone back to the back --

MS. DROUIN: Where do we say that?

MR. BLEY: We do say that, Mary. And we say that because of the uncertainty. The mean value as best we can tell it will be below there.

MS. DROUIN: Right.

MR. BLEY: We have to acknowledge that there is some small chance that some will slip above it.

CHAIRMAN KRESS: Absolutely.

MR. BLEY: and therefore we have protection against that.

DR. WALLIS: We regulate so they don't go above it. We've got a clear goal.

MR. BLEY: It's real hard to have a 100 percent certainty of that.

MR. LEHNER: I mean, this is an issue of completeness on certainly for one thing, especially with the new reactors.

CHAIRMAN KRESS: Absolutely. Model uncertainty --

MR. LEHNER: So you can't guarantee that they will --

DR. WALLIS: But then you could say they've got to meet this with some percentage, or something, at least it's a goal they're meeting.

MR. LEHNER: Yes.

MS. DROUIN: It's the mean value.

MR. ROSEN: The mean value meets the goal?

DR. WALLIS: The mean speed limit of the cars is the speed limit? Now wait a minute.

MS. DROUIN: We're going to get into that.

CHAIRMAN KRESS: We're going to get into that.

MS. DROUIN: We'll get there.

CHAIRMAN KRESS: But before you leave this slide, you know the ACRS has called for at times a three region approach, which this looks like but I wanted to point out it's not exactly what we had in mind. What we had in mind for a three region approach would be three regions in that green part. At the safety goal level, you'd have a region above it which would be unacceptable and then you'd have a region that's tolerable just below the safety goals. And then a fully acceptable region as a third one.

So when we had in mind three regions, we had in mind that green part being divided into three regions. And that's a way to show a defense-in-depth accounting for uncertainties and being able to accomplish those things. So one of our points would be that these are not the three regions we had in mind.

MS. DROUIN: I understand what you're saying.

CHAIRMAN KRESS: Yes.

MS. DROUIN: You want to take the three region that we had here and have another three region, which is the same, that collapses down into the green?

CHAIRMAN KRESS: Yes. This is strictly for new reactors.

MS. DROUIN: For new reactors?

CHAIRMAN KRESS: Yes. And to account for uncertainties and things we don't know about being able to do it.

MS. DROUIN: You could perhaps do that.

DR. WALLIS: So you'd simply put safety goal up to adequate protection essentially?

MS. DROUIN: No.

DR. WALLIS: Have the new reactors like what's in here called current.

CHAIRMAN KRESS: And get rid of the current reactor.

DR. WALLIS: But you'd move the safety goal up to the -- it would be the definition of adequate protection.

CHAIRMAN KRESS: Yes.

MS. DROUIN: But that's a different question than what we're trying to show here, different issue or different point.

CHAIRMAN KRESS: Yes, that's a point I wanted to make.

MS. DROUIN: It's a very good point.

MR. ROSEN: You're trying to show how this fits in with the current --

MS. DROUIN: We're just trying to show how it fits in with the current and with the expectation from the Commission that the new plants will be substantially safer. So we have this expectation from the Commission and we're saying here's how we're going to try to meet that expectation.

CHAIRMAN KRESS: Yes. And the other point about that, and the reason I would like to see three reasons in the green, is we're still balancing around the kind of 10 to the minus 4, 10 to the minus 5, whereas the rest of the world, the utility requirements documents and all the new plants are coming in at order of 92 less than that. And if you had three regions in there, you could almost say this accommodates what the rest of the world is doing also.

MS. DROUIN: Absolutely. And it would also answer Graham's question about not allowing anybody above the green into the yellow if you divided the green into three regions.

CHAIRMAN KRESS: Yes. They still could get up there. Because you're just dealing with the uncertainties and you don't really know how big they're going to be. So it's possible it could be up there. But if the assessment showed them to be up there, then it would be unacceptable.

MR. KING: What you're proposing is a fundamental change in the way we think about regulation.

CHAIRMAN KRESS: It is. It is, and that is a fundamental change. It defines some new goals for the new reactors.

MR. KING: I mean, what we're proposing is --

CHAIRMAN KRESS: I don't know if you can get away with that or all.

MR. KING: Yes, it's truly a policy issue. And what we're proposing I think is a fundamental change, too. It may not be as far as you've gone, but either one is --

CHAIRMAN KRESS: Yes. I've just gone a little further and I'm masking it saying it's taken care of the uncertainties. And the other way to take care of the uncertainties, addressing one of Graham's thoughts, is that instead of saying the mean for these things, you might have a confidence level on the mean. You're still dealing with the mean, but you're dealing with a confidence level on it. And that also can be a defense-in-depth way of calculating uncertainties.

MS. DROUIN: At one time we had played

with doing it that way, too.

CHAIRMAN KRESS: That's a policy, once again that's a policy issue.

MS. DROUIN: Yes.

MR. BLEY: Of course, the areas where there's very broad uncertainty, the mean can be well up above the 90 percentile.

CHAIRMAN KRESS: Oh, it can up to 95, yes.

MR. BLEY: It can be way up.

CHAIRMAN KRESS: Especially when it's a log normal distribution

MR. BLEY: So it might not be really clearly better to put it at say 90 percent, because the mean can well above that.

DR. WALLIS: I have another suggestion for you. This is a safety philosophy. Don't use the word risk on this picture at all. You're talking about safety goals, adequate safety, acceptable safety and so on at a very high level here. Then later on you can bring in risk, but it's not risk -- this is your view of public safety. This isn't tied core damage frequency and that kind of stuff. No, it's a different thing.

You can bring in the QHOs if you like,

but you mix this in with these surrogates very early level. Do you see what I mean? You're here at the level of the Atomic Energy Act. This is safety philosophy.

DR. RANSOM: I agree with that.

DR. WALLIS: What's adequate safety.

MR. KING: But there's a relation. I mean if it's not adequate safety, it's going to be higher risk than something that is adequate safety.

DR. WALLIS: You don't want to risk based. Risk is means things. But you're talking here about your approach to public safety. I would prefer you to do that. Because you get all tied up with different meanings of risk and saying oh we're being risk based and so on. But you can't talk about levels of safety. Maybe you get out of the box. And that's where -- I think they're in that level. They're not at the risk level.

DR. RANSOM: I tend to agree. I think here the jargon is risk, but in reality it's risk avoidance.

DR. WALLIS: But safety.

DR. RANSOM: Or that's what you're trying to do.

DR. WALLIS: But safety.

MR. BLEY: I think 20 years ago we started using risk to be more precise about what we knew about safety. So maybe it's time to turn back.

DR. WALLIS: Well, you say it. You have this bold statement achieve the safety goal level of safety, right. So it's a suggestion; that you talk about safety on one page and then later on you talk about risk as being a measure of this safety.

DR. SHACK: Just to come back to Tim, I mean, you do bring in the 10 to the minus 5 guideline. I mean, you know, you call it a guideline, so it's perhaps not as strong, but you certainly are not as divergent from the rest of the world as Tom's argument might have made you seem.

MR. KING: Yes, we'll get to it.

MS. DROUIN: Correct. But I was curious, Tom, in your suggestion on this three region approach, is there something written up on this that we can refer to or this is just --

CHAIRMAN KRESS: Well, we had a letter at one time. For the life of me, I couldn't --

DR. SHACK: But I don't remember that letter saying what you said it did.

MR. ROSEN: Yes. I couldn't recall seeing that either.

DR. SHACK: Since I wrote a dissenting comment on that or an added comment, I sort of remember that letter.

MR. MUBAYI: But the letter that I remember was written in 1999. I have a copy of it. And it talks about the three region approach in terms of the core damage frequency, if you recall. And it was for the current reactors, not for future reactors.

CHAIRMAN KRESS: Oh, yes, we've never said how to apply to future reactors.

MR. MUBAYI: Right.

CHAIRMAN KRESS: But if you take the thinking and apply it to future reactors --

MR. MUBAYI: And it talked about 10 to the minus 4 and even mentioned 10 to the minus 3 as the upper level.

CHAIRMAN KRESS: Oh, sure. But we were talking current reactors. But the reasoning was that this took care of uncertainties. Now we're going to deal with an expectation of a better level of safety, and also deal with uncertainties by a three region approach. so if you take the thinking behind that and transfer it to reactors, you do just what I said. You have a three region approach in the green. So it's not lie behind it, not the actual numbers.

MR. MUBAYI: Right. And we have something like that, as you'll see very shortly.

MS. DROUIN: But you're always going to that. We'll go resurrect that and look at that.

Okay. Now what we want to try and do is go back to each of these and get into more detail on each of them. And at this point, Dennis is going to walk through chapter 3 that we call safety fundamentals.

MR. BLEY: Well, after the last discussion, I rather wish we were starting with chapter 4.

We're beginning with protective strategies. And I guess there are many different ways to thin about which way to organize this, but this from point of view we want to get at what are the protective strategies. And this is kind of an overview viewgraph and we'll get to the details in a second. There are five. We start with -- oh, that's different from the hard copy I have here.

DR. WALLIS: You've just divided it.

DR. SHACK: Or else you're not updating.

MR. BLEY: Oh, we skip one here, Mary.

DR. WALLIS: No, there are five there, it's just that you've got them under two blue bullets.

MR. BLEY: Yes, but we're missing.

DR. WALLIS: Under the top blue bullet.

MR. BLEY: That's different than this one. Okay. Let me look at the one you're seeing.

We have barrier integrity, limit the initiating event --

DR. WALLIS: Now, could I please ask for congruity here. I mean, these are things; barrier integrity, protective systems, accident and "limit" is sort of a verb. Could you call it initial event limitation or something so that there is consistency here about a strategy as a thing? It just jars, it just jars.

MR. BLEY: Yes, I hear you.

CHAIRMAN KRESS: Yes. And along those same line, I just wish you would purge the word "barrier" from this whole document. Because it's too much of a connotation of current LWR barriers. And what I think you really mean is the compensatory measures that the Commission talked about in their white paper on defense-in-depth rather than barriers. And, I wish you would just get that out of it altogether and talk about compensatory measures instead.

MR. BLEY: Tom, yes, why don't you talk about that?

MR. KING: Well, we meant barriers. I mean that --

CHAIRMAN KRESS: Well, that's what I thought you meant.

MR. KING: Yes, when we put that word in there, we had certain things in mind. And it doesn't mean everybody's going to have a LWR containment. We didn't intend it to mean that.

CHAIRMAN KRESS: But, well you know everybody's going to have two barriers. They're going to have a fuel and then they're going to have a primary system. I mean, you can't have a reactor without those two.

Now, the barrier also connotates to me a containment. And, you know, you could talk about the fuel and the primary system and other things as successive compensatory measures.

MR. KING: So you would call it confinement and compensatory measures?

CHAIRMAN KRESS: Yes. And I would call a containment a compensatory measure also. But I would also call other things that, compensatory measures.

DR. SHACK: Yes. But this to me much more graphic as far as a strategy. I mean, what is a compensatory measures? I mean you work on the barrier, you limit the frequency, you have a protective system. It just seems to me much more descriptive of ways that I would actually try to do this compensatory sort of thing.

CHAIRMAN KRESS: Well, you know, I would have talked a different set of strategies. They're the same ones, but I would have, for example, my five might have been -- I would start out by in some sort of chronological order. I would say limit initiating event frequencies. And the next strategy would be limit release of fusion products from fuel. The next strategy would be limit exposure of workers in the control room. And the next strategy would be limit release to the environment. And then a final barrier or strategy would be limit exposure to the public. And you could fit all this into that, but to me it's a little more consistent and it gets you away from talking about --

MR. BLEY: It's different than what we were thinking of here. I see your point, and we've talked some about that. Those are functional results that we certainly want.

CHAIRMAN KRESS: Yes.

MR. BLEY: The thinking here was these and the next viewgraph given some more examples on them, these were barriers and we've not had 100 percent agreement on exactly what we mean by barriers, but there are things in the design that keep the hazardous material away from the workers, the environment and the public. And the structure then says everything else is protecting those barriers to some extent to either successfully or unsuccessfully that makes this new design effective in meeting those functional requirements I think you just went through. So it's a real different structure than what we were aimed at here.

CHAIRMAN KRESS: Yes, well that was a bit my problem, I think. You're getting too much into the actual design here, whereas these other things are things you want to accomplish by the design. And sure enough, these could be part of these limits, it could be these.

DR. WALLIS: And if you really want strategies, I'd offer you something that's what a strategy? Prevention, mitigation, limitation, retention and response or something like that. Those are strategies.

CHAIRMAN KRESS: Yes, that was my point. Those are words for strategies.

DR. WALLIS: Rather than specific things like barriers.

CHAIRMAN KRESS: These are things that are part.

DR. WALLIS: Strategy is the way you go about something, you know. We're going to prevent it, we're going to mitigate it, limit it, retain things and respond. Either put it in verbs or nouns, I don't care, as long as they're consistent. Doesn't that make more sense?

MR. BLEY: I wouldn't say it makes more sense. I think it makes very good sense, but this one -- and I guess from the way you began, Tom, the current cornerstones or operational thinking start with the first thing that happens. Here we were thinking design. We're saying what's the first thing happens from design; you build a design with certain barriers that keep the bad stuff from the good places. And then even though you have those, you want to protect them by limiting initiating events, by having protective systems that in fact protect those barriers if they still fail by having accident management to control what happens beyond it. And there's almost a separate thing, physical protection which we don't go into anymore detail here because it's being worked on else. But to prevent external attack causing any of these things. So it's a difficult structure, I would suggest.

CHAIRMAN KRESS: Yes, I don't think it's bad. It's just that I wouldn't have done it that way I don't think.

MR. BLEY: But I think we could make clear what we're after from a combination of the two kinds of things.

MR. KING: Yes. I think what Graham suggested is fairly close to what we have.

DR. WALLIS: It is. Just need to wordsmith it, perhaps.

MR. KING: Yes.

MR. BLEY: Although the two words we've avoided just a little are prevention and mitigation because depending on where you are in the scenario, the same thing can be one or the other.

CHAIRMAN KRESS: I applaud you for that. I think you should avoid that.

MS. DROUIN: I mean, we were trying to

avoid those two terms. We were also trying to avoid the word "cornerstone," because we didn't think that carried a lot of meaning to it.

CHAIRMAN KRESS: I think you can avoid that.

MS. DROUIN: And I'll tell you, we've gone through so many different words of what to call these and every one of them had problems. And we finally just settled on protective strategies. But what we're ultimately trying to say is that this is what we're going to write our requirements to.

MR. BLEY: So again, I'll go and talk about these protective strategies and we'll keep the other ideas in mind. And we've certainly bickered and thought about those things, too.

CHAIRMAN KRESS: Well, I think what we understand about these are going to apply equally to the --

MS. DROUIN: Yes.

MR. BLEY: Yes. I mean, some of them we all know exactly what they mean, but it's different to each of us.

Well, are these five sufficient? We have two reasons to think they were. The first one is really an engineering judgment, a thing that we had developed but it really comes from lots of previous work that come up with very similar things. And it looks on these fie things as a way to provide defense-in-depth to protect against uncertainties, both completeness and modeling kinds of uncertainties. And especially with new designs where we'll have some kind of technical knowledge gaps that until we actually get experienced, we're going to get some surprises along the way.

The other thing that makes us like these is a mapping of these elements onto PRA. And I'll tell you what I mean about that in two slides.

And then if we have these and if we want these to exist, how do we get from here to technology-neutral requirements, and that's a bit of a top-down analysis we showed in some of the figures in chapter 3, all of which for each one of these looks at design, construction and operation --

DR. WALLIS: Let me go back to this other thing. The problem you always have with engineering judgment is how much is good enough, whereas with PRA you might even have a number or something to measure how much is --

MR. BLEY: Exactly. And we combined both those.

DR. WALLIS: And then you're saying why are they sufficient:? Well, that's sort of begging the question because how much engineering judgment is good enough, you know. Are you're asking the question, you'd still have the question about what's sufficient when you ask how much is enough. Are they necessary?

DR. SHACK: Are they necessary?

DR. WALLIS: Yes. Do you need to have a containment?

CHAIRMAN KRESS: Yes. I think what he's saying is I would just purge the words "engineering judgment" out and leave the words "defense-in-depth" is the reason they're sufficient.

DR. WALLIS: Again --

MR. BLEY: And in alignment with the PRA that I'm going to show you in just a second.

Well, what did we mean by these things? We've probably already covered for this. For barrier integrity, we wanted barriers adequate to protect the public from accidental radionuclide releases.

DR. WALLIS: Accidental or deliberate?

MR. BLEY: I'm sorry, I didn't hear you.

DR. WALLIS: Or deliberate? I mean,

it's all accidental?

MR. BLEY: If you'll remember, we put aside the physical protection --

DR. WALLIS: Sabotage is not being 00

MR. BLEY: -- because it's being worked on elsewhere. And if it does have a place in the framework, we just didn't include it at this point because of other work going on.

DR. WALLIS: So that if future reactors do not respond to this deliberate release threat, they will not be built?

MR. BLEY: Exactly right. And we've said that once the other work on that's done, it'll be incorporated in. We didn't want to bicker with the other part of the staff that's working on that.

MR. ROSEN: And you show that on your next slide.

MR. BLEY: Right. And we showed it on the one before.

DR. SHACK: And you can just leave out accidental.

MR. BLEY: On this one? Okay. That's not a bad idea. Except that's been our focus.

MS. DROUIN: Ultimately physical protection security will be integrated in but at this point in time --

MR. BLEY: We've just got placeholder.

DR. SHACK: The barriers do a lot of work on even non-accidental.

MR. BLEY: They do. And the point of view that they're add-ons to the design -- any good design will probably have these anyway. The question is how far they go.

We want them to be adequate functional barriers to limit the effects of accidents and --

DR. WALLIS: What's the difference between that and the first one?

MR. BLEY: Functionally --

DR. WALLIS: What other effects are you worried about than radionuclide releases? What other effects?

MR. BLEY: I think we're a little redundant on that bullet.

Yes.

CHAIRMAN KRESS: I may have a little problem with the second bullet --

MR. BLEY: Okay.

CHAIRMAN KRESS: -- in that I like to see eventually some sort of quantitative goal for the various things. I don't know how you can get a goal for initiating event frequencies. I could see how you could get a goal that'll limit fusion product release from the fuel. You could have a goal for that. But I don't know how you can -- you know, you design your best to get rid of initiating events, but not the frequency. You just try to get rid of them if you can design them out, like for example the IRIS is attempting to get rid of a lot of the initiating events. But I don't know how you have a goal for initiating event frequencies.

MR. ROSEN: Well, you could do it, I think, Tom. Let me answer your question in operation. For instance, you could say if the plant suffers a loss of offsite power more frequently than X, then the tech specs control, there's some provision in the tech specs. So you can say that it can't go beyond that because then the tech specs would kick it. Maybe one could do something like that, external to the design.

MR. BLEY: I think you could. If you go back to that picture that Mary showed --

CHAIRMAN KRESS: Yes. I'm picturing a certification, though. And these he's picturing an operation. Now you guys are dealing, I guess, with our regulation you have to deal with everything.

MR. BLEY: But can I really address that one. If you'll remember the picture Mary showed with the boxes, the chapter 5 box down there and talked about defense-in-depth. And it's at that level when you've got the PRA done, you've got some design basis work, you've got these protective strategies basic to the design where you compare quantitative results from the PRA, quantitative and qualitative acknowledgements of the uncertainties and have to make decisions about are your initiating events at low enough frequencies that they're tolerable to keep the risk low. So those decisions are made down in that thing that's talked about in chapter 5. They don't associate up at this level.

CHAIRMAN KRESS: Suppose your judgment is that they're not low enough, then what do you do?

MR. BLEY: You redesign as you need to.

MR. ROSEN: Or you place operational limits on the plant.

MR. BLEY: Or you place operational limits, that's right.

MR. ROSEN: If the plant is already designed and built.

MR. BLEY: But if this is already in place at the time you're doing your design, you ought to be thinking about that from the beginning. Even though what we're doing is guidance for staff, it's there for everyone to see. And you'd be working that in from the beginning. You might be building some of it into the I&C. You'd certainly be building some into the design trying to preclude them, as you were saying.

DR. SHACK: Yes. I mean, virtually all the new designs have features that essentially eliminate some set of events. And the IRIS to track the--

CHAIRMAN KRESS: Yes, but that's not limiting the frequency. That's yes and no thing.

DR. SHACK: Well, that's the ultimate frequency limit.

CHAIRMAN KRESS: It certainly does limit some frequencies. But if I have an accident initiator, I don't know how to limit its frequency.

MR. ROSEN: Well, I do. I mean you design a more robust offsite power system with more lines coming in from different directions, from different sources.

MR. BLEY: You design additional protection against earthquakes if that happens to be the problem where you're coming. I think it's not easy.

CHAIRMAN KRESS: But that doesn't limit the initiating event frequency. It does something about it.

MR. BLEY: Oh sure it does. Is the initiating event the earthquake or what happens to the plant from the earthquake?

CHAIRMAN KRESS: It's the what happens then.

MR. BLEY: Yes.

CHAIRMAN KRESS: It may have been the initiating event is the earthquake, and that has a certain frequency --

MR. BLEY: No, not to me.

MR. ROSEN: No, and not to me. And the loss of offsite power is what happens to the switchyard. I mean, is there a power to the safety buses or not. And if there isn't, then you haven't had -- I mean, if there is power to the safety buses, then you haven't had a loss of offsite power.

CHAIRMAN KRESS: Okay. I'll cede this one.

DR. WALLIS: You could reduce initiating events to zero with proper strategies.

MR. BLEY: Well, at least you think you

did.

DR. WALLIS: You probably could.

CHAIRMAN KRESS: Yes. So there's a question of what's an acceptable level of initiating event frequency.

MR. BLEY: And that takes you all the way back to the QHOs.

CHAIRMAN KRESS: And I don't know how you're going to arrive at that.

MR. KING: Well, I think you know.

DR. WALLIS: Just the balance.

MR. KING: You look at how they affect overall things like core damage frequency.

DR. WALLIS: Right. Right.

DR. SHACK: I don't think you're setting your limits down at this level.

CHAIRMAN KRESS: My point is you set the limits somewhere else.

MR. KING: Yes.

DR. SHACK: But these are still strategies to get at those limits.

CHAIRMAN KRESS: Strategies to get to that level. But I don't think you have a goal for them.

DR. SHACK: No. But they're not talking

about goals. They're talking about strategies at this point.

MR. BLEY: That's going to be true for the next one, too, the protective systems. How much of them do you need, how much redundancy, how much diversity. That's a balancing.

CHAIRMAN KRESS: There you backslide.

MR. BLEY: I'm sorry?

CHAIRMAN KRESS: You backslide there. You put in prevention and mitigation.

MR. BLEY: Yes, I did.

CHAIRMAN KRESS: See if you can word that differently.

DR. WALLIS: Well, it occurs to me, you said this was for the NRC. But this is equally well requirements for design.

MR. BLEY: Of course.

MS. DROUIN: Of course it is.

CHAIRMAN KRESS: Of course it is, because he's going to have to meet the regulations.

MR. KING: But how does NRC translate these concepts and principles into --

DR. WALLIS: But I mean, I'm surprised that you said this was only for the NRC.

CHAIRMAN KRESS: Well, right it probably

is.

DR. WALLIS: But then you publish this, and the designer says gee wiz, we got to meet all this, we'd better make our system met it.

MR. BLEY: I think what we said was it's guidance for the NRC staff to come up with a regulation.

CHAIRMAN KRESS: A regulation, yes.

MR. BLEY: And those regulations then will be what people will work against, although the philosophies here are --

DR. WALLIS: In other words, you implement these various things?

MR. BLEY: We're running out of these.

CHAIRMAN KRESS: On accident management, the bottom one.

MR. BLEY: Yes. Okay.

CHAIRMAN KRESS: It could be other things besides emergency response?

MR. BLEY: Yes, it could.

DR. WALLIS: An awful lot more.

CHAIRMAN KRESS: But my question here are you going to try to in your strategies meet the -- let's say it's a QHO that you're trying to meet. Are you going to try to meet those without emergency response so that emergency response becomes truly defense-in-depth.

DR. RANSOM: If you look at the GEN IV from DOE and the international group, that's their goal.

CHAIRMAN KRESS: That's their goal. But you don't --

MR. BLEY: But in case they don't need it --

CHAIRMAN KRESS: It's sort of a reinterpretation of the safety goals if you do that.

MR. KING: Well, not necessarily.

CHAIRMAN KRESS: Not necessarily, you're right.

MR. KING: The subsidiary objectives we proposed, which we get to later, are based on the assumption that there's no offsite evaluation. So future plants that come in and really want to eliminate offsite evaluation if they meet those goals, then that would be at least in our view acceptable from a risk standpoint.

Now, they are also going to be given an open door that if they don't like our goals and they want to meet something else, they could propose some EP or some other features on their plant that would say, well, I don't like your 10 to the minus fifth CDF, I want 10 to the fourth and I'm going to have EP or I'm going to have something else to justify the difference.

CHAIRMAN KRESS: So you're not ruling that out?

MR. KING: Not ruling it out. But we are trying to --

CHAIRMAN KRESS: I would rule it out if it were me. But I'm not a radical, no --

MR. ROSEN: We would like to rule it out, but even if we did we're not saying there wouldn't be an emergency plan.

CHAIRMAN KRESS: Oh, no. You should have it --

MR. ROSEN: But it would be different. It would be different than the ones we have now.

MR. KING: And that's what we talk about in there in the fine print.

MR. BLEY: Yes, we require it but the way it's structured will depend on all the other pieces.

MR. ROSEN: Right. Because it's an element of defense-in-depth.

MR. BLEY: But you can't throw it away

completely.

MR. ROSEN: No, and shouldn't.

MR. MUBAYI: We have (off microphone).

MS. DROUIN: Use the mic.

CHAIRMAN KRESS: You need the microphone.

MR. MUBAYI: Maybe completely different from what it does at the present time, but there will be that element of the defense-in-depth, but the two accident prevention and the accident mitigation or the equivalent of that would satisfy the QHOs without the need for any offsite measures.

DR. WALLIS: Accident management is far more than you say here. I mean, it's what the operators do and all the emergency operation plans and so on. It's like the analogy if you have a plane and the landing gear fails to open, to come down, what do you do? If an engine fails, what do you do? If a part of the tail falls off, can you handle it? It's all kinds of things like that. It has an analogy in the nuclear situation.

MR. BLEY: And the last figure in chapter 3 tries to deal with that as a first cut. We think we really haven't done that --

DR. WALLIS: I think modern reactors,

better reactors could be much easier to handle in accidents.

MR. BLEY: Absolutely.

DR. WALLIS: It's not so difficult to figure out what's going on, for instance.

MR. ROSEN: And you have much more time.

DR. WALLIS: A much longer time to do things, right.

MR. BLEY: Well, I guess one worry for me is some of the passive systems, maybe if they don't work right for some of aging reason might be very difficult to figure out.

DR. WALLIS: Well, then you put in an active pump somewhere.

MR. ROSEN: Well, the passive systems to me introduce, and I think the report says this, new modes of failure that are we don't know about.

CHAIRMAN KRESS: Yes, that's why you need defense-in-depth.

MS. DROUIN: Right. And when we get to chapter 5 what you'll see, we're going to go back through all these protective strategies again and how you have to meet them is going to depend now where you are in your risk area and how well you meet your QHOs or the surrogates that we've had there.

MR. BLEY: This next viewgraph has a couple of purposes, but the one is it's the second look at why we're comfortable with those strategies we identified.

If you'll just look at the top row and not look at that lavender box, big box at the bottom to start with, it's sort of a map of what's in a risk assessment. It starts with the initiating events. It goes to the protective systems in light of the barriers that are in the design, those set and what the protective systems need to do to protect those barriers.

Next it looks at the human actions in the plant in light of the barriers and protective systems.

Next it models the integrated systems response all the way out through releases and transport and doses as well as whatever we mean by core damage in the new design including you could look at routine releases this way.

Then it looks at the emergency response work.

And finally, calculated doses to workers and public and health effects and contamination and property damage.

Well, where do these five strategies interact with that PRA model? If we go over to the PRA initiating events, both limit the frequency the initiating events and physical protection. The bottom group here are involved in the initiating events of the PRA.

Three of the barriers --

DR. WALLIS: What's the difference between physical protection and protective systems?

MR. BLEY: Physical protection is the security aspect.

DR. WALLIS: Oh, I see, security aspect. Okay.

MR. BLEY: Yes. That's the buzz word for--

DR. WALLIS: That's the buzz word for security?

MR. BLEY: Yes. We have that fifth -- I'm sorry. Right from the beginning we had the fifth strategy which was physical protection and security. We aren't expanding it, but this is just showing where it would interact with the PRA model.

Then when we look at the protective systems, the barrier integrity, the protective systems and of course physical protection would interact. When we're looking at the human action sin the plant, the barrier integrity, protective systems and accident management are involved. And finally when we get to the --

MR. ROSEN: Well, hold it right there. I think you should have physical protection in that column as well under human actions. Because there is this risk of the insider.

MR. BLEY: Okay.

MR. ROSEN: and other activities.

MR. BLEY: Yes, I'd buy that.

DR. WALLIS: Where does the idea come in here that you have such a good design, it's so forgiving that you don't really need to protect anything?

DR. SHACK: That's hubris.

DR. WALLIS: No, there's no such thing.

Everything here is in the idea of protection. But can't you do things with the design to make it more forgiving in the result of the result of these events so that it doesn't lead to any kind of catastrophe inherently?

MR. BLEY: I think, of course, you can and we'd like to see that. And in chapter 5 in

Mary's drawing is where you balance these things. If you can very get very low calculated risk with essentially none of the barriers -- well, you probably can't. You need at least some. Our approach would still say you need to cover all five protective strategies, but the strength with which you protect them would depend on that calculation and on a real careful look at where the uncertainties could lie, especially the ones and what might we be modeling improperly, what might time and operation change in the plant and where might we have some gaps in what we know. If you treat those quantitatively as possible but at least make an exhaustive search for them, that combination would allow you to decide how much of each of these you'd need.

Now how that would work out practical basis, we haven't gotten there yet. That's probably not an easy thing to do, but that's where we're headed.

CHAIRMAN KRESS: Yes, I think you need--

MS. DROUIN: But that's up to the designer.

MR. BLEY: Yes.

CHAIRMAN KRESS: I think you would need

confidence levels on well you meet the goals.

MR. BLEY: That's right. But I think even beyond the confidence levels, before them you need a real qualitative look at those uncertainties.

CHAIRMAN KRESS: Yes. Because I don't think there's any way you can really quantify the full uncertainty for the new plants. For example, model uncertainties will be difficult to come back.

So you do what you can with the uncertainty and you put a confidence level on what you can and then you deal with all the other parts of the uncertainty, I think, with this sort of defense-in-depth. And one way to do, which I liked about what you did, to just talk about design basis accidents also as something you have to do. And to me, that's a way to deal with these uncertainties, part of it.

So, like I say, I like sort of what I heard in there.

MR. BLEY: But even there we're calling how you pick those design basis events from a risk thinking point of view.

CHAIRMAN KRESS: Yes.

MR. BLEY: And we're still struggling with that. So your ideas there will be real helpful.

If I could give you just an aside. I did some work the last couple of years, the last ten years, with the Army's chemical weapons folks. And a couple of years ago they had a small group look at the risk of some new technologies they were looking at using. And those came out, despite some fairly extensive experimental programs with what we were calling technical knowledge gaps, places where depending on how the real world turned out to be within what we saw in the experiments, the risk of either very high or very low.

And they eventually when they went out for bids on doing their contract for the first time ever, they required the contractors to identify what they saw as those major knowledge uncertainties and incorporate in their proposal a plan for dealing with them up front such that if they really hit them when they came in, and they already had an evaluation of them, they could use that as part of their judgment and build a first phase of the project that had to clear those up or pick different alternatives for the designs. And some of that thinking ended up in the Gen IV work and some of its kind of embedded through here, too.

The last viewgraph I have, and we're over where we wanted to be at this time, just tries to pull all of this back together.

The protective strategies provide a key element of defense-in-depth to protect against uncertainties both state of knowledge uncertainties and especially completeness in modeling kind of state of knowledge things.

We tried this top-down approach as a first cut, and some of those figures you saw in the end of chapter 3 were for each of the protective strategies. We looked at design construction and operations. And under design we looked at things effecting reliability, things affecting performance and things affecting risk. Under construction we look at the onsite construction and the component fabrication. Under operations we looked at the operators themselves, at maintenance and configuration control and tried to spin out a list of how requirements might align under each of those. That's very preliminary, that's why I didn't have a viewgraph in here. But it was a first cut.

CHAIRMAN KRESS: But I thought that was a good way to structure.

MR. ROSEN: One minor quibble, Dennis.

MR. BLEY: Yes.

MR. ROSEN: This idea of risk associated with design and construction is troubling.

MR. BLEY: Yes.

MR. ROSEN: There is no risk associated with design with public health and safety.

MR. BLEY: Well, not during. Well, I'm sorry, to the workers there is some then.

MR. ROSEN: Well, yes.

MR. BLEY: But resulting from what happened in design and construction, and we're certainly thinking that way.

MR. ROSEN: That's right, but it isn't clear here.

MR. BLEY: Okay. Good point.

MR. ROSEN: Dropping heavy loads on workers isn't very --

DR. WALLIS: More people are killed during construction of nuclear reactors than ever during operation.

CHAIRMAN KRESS: Well, at least in this country. But that's NRC's job to worry about it. We'll let OSHA worry about that.

MS. DROUIN: But I just want to elaborate a little bit on that. You know, we didn't put up there any of those kind of fault tree type figures for each of the strategies, but it's a very important element of our framework. Because that is showing that the thinking of how we're going to go from each protective strategy to writing the requirements is taking this, what I would call this systems analysis approach to each of them and breaking them down into their various parts of, you know, what you need to succeed and what possible challenges you need to overcome to achieve those protective strategies and break it down in this deductive type thinking process.

MR. BLEY: Yes. And I suppose you're depending on what kind of systems and cycles are looked at in the future, there are some things. I don't know if they fit under design or construction in other parts of the fuel cycle that might have risk that MNSS would look at. But our focus here is on reactors and somebody will be looking at that.

CHAIRMAN KRESS: Don't worry about how to do this for the others. Let them.

MR. BLEY: Yes. And there's a big link between what we've been talking about here and our first cut at some of the requirements in chapter 6. And that's a real first cut -- you know, that's the last thing we really got started on, and I hope we get to a little of that anyway today.

CHAIRMAN KRESS: How late can you stay?

DR. WALLIS: Well, the requirements are the key thing, aren't they? They're actually how you're actually going to implement it. You just told us about implantation of any of this.

MR. BLEY: Except, yes, those poetry-like pictures that we didn't put on the board.

MS. DROUIN: Implementation is chapter 6.

DR. WALLIS: What are you actually going to do? What are you actually going to require? What is going to be the mechanism for making this happen?

MR. BLEY: That was the link. Chapter 6 is where we talk about those.

DR. WALLIS: Well, let's get there.

MR. BLEY: Let's get there, okay.

CHAIRMAN KRESS: Well, let's get there--

DR. WALLIS: Of course we don't get to chapter 11.

MR. BLEY: There's some other guys out writing it, right.

CHAIRMAN KRESS: I don't know about

chapter 6, we need to get to the rest of this stuff.

MS. DROUIN: Okay. Now we're getting to get over to chapter 4, the first part is getting into the risk objectives. Vinod is going to walk through this first part.

MR. MUBAYI: Yes. If you go to the first slide. I'm going to talk about the public health and safety objectives that we put in the framework. The first is, obviously, to provide protection during normal operation.

The second part is to be consistent with the Commission safety goals, which is the QHOs. And one way of demonstrating that is through a frequency consequence plot that looks at events, accidental events in terms of consequence and frequency and is broadly consistent with the safety codes.

MR. ROSEN: Now before you get off that, the protection during operation means protection during all modes of normal operation.

MR. MUBAYI: All modes of normal operation.

MR. ROSEN: Okay.

DR. WALLIS: How can a frequency-consequence plot which is two dimensional be consistent, in any way will it be consistent at an integral level with a one dimensional safety curve

MR. MUBAYI: It's provided by the area under the curve.

DR. WALLIS: That's right. And it's a total, it's a one dimensional.

MR. MUBAYI: I'll explain that in a minute.

DR. WALLIS: There are many ways to get the same --

MR. MUBAYI: There are many ways to get the same answer. It's by no means a unique answer. And we are just putting it up for illustrative purposes, too. Because if you're grossly outside that, you're not likely to be, you know, in consonance. But from as point of view of a designer or a reviewer, if he does see events that lie well outside that, you know you have some information.

CHAIRMAN KRESS: And there's where one of the roles I see for the design basis accidents.

MR. MUBAYI: Correct.

CHAIRMAN KRESS: To keep that from happening.

MR. MUBAYI: Correct.

And they've been chosen so as to provide some measure of consistency with the DBAs that are defined later in the chapter and they're also consistent at least to first cut with the safety goals.

Now, the next slide, protection during normal operation for the public is provided by the system of dose limits that we have, Part 24. And the 100 millirem a year from licensed operation plus ALRA is protective of the public. And this is, of course, consistent with the recommendations of the ICRP and the NCRP. And we have Part 20. So the events that we deal with will make sure that the framework mentions this, it's an important component of overall radiation protection.

Now, the risk limits that went into this frequency-consequence plot were developed from recommendations that are made in ICRP-64 which talks about potential exposures, by which they mean accidental exposures, that is those that are not considered as planned operation. And they provide some frequency ranges that are of interest in terms of what they would consider as providing a measure of protection, providing a measure of risk of limiting the risk from certain ranges of exposures.

So the stochastic effects only, but above dose limits. Which means roughly in the range of about 20 to 25 rem you're mostly in the stochastic region where BIER V risk factor provides a measure of what the risk of -- the only outcome there is cancer in those exposures.

When you go significantly above that you have a chance of deterministic effects, either of injury to various organs or if you go sufficiently above that, you have of course chance of acute fatality.

So the range they give, which is a very broad range, stochastic effect only but above those limits, which is less a 100 millirem to let's say 20 to 25 rem, you got a range of 1E-2 to 1E-5 doses where some radiation effects are deterministic, which would be, say, 50 rem whole body and higher or 50 rem effective dose equivalent and higher. 1E-5 to 1E-6. And doses where that is a likely result, which for our purposes we could take to be for purely screening 200 rem and higher whole body doses as a screening parameter, less than 1E-6.

And, of course, we have our QHOs which say early fatality less than 5E-7 and the latent cancer fatality less than 2E-6 per year as our current QHOs, which are --

MR. ROSEN: I think that doses where

death is a likely result is strong terminology. Most people wouldn't understand that. The way you're talking is the median lethal dose, more than half -- half or more of the people will die, but not everybody will die.

MR. MUBAYI: No, sure.

MR. ROSEN: And that implies everybody will die. And I think that's important to say.

MR. MUBAYI: This language is directly from ICRP-64.

MR. ROSEN: Yes.

MR. MUBAYI: I didn't want to second guess their language. This is an identical quote.

Now, it's interesting whether they mean how we interpret this. Do we interpret it as an LD-50, do we interpret as a threshold that we use in our consequence curve? For example, we used the LD-10 as the threshold level or do we mean -- which organ do we mean? Do we mean the red blood marrow, which you know at low doses is a much lower threshold? Do we mean lung or, you know, gastrointestinal tract or some other organ which has a much higher dose for an LD-50.

I think it's probably not useful to be too prescriptive in this, but to use it as a screening parameter. And traditionally in many NRC analysis over the last 20 years 200 rem has been used as a kind of threshold whole body --

MR. ROSEN: I understand all that. And I think your language here is precisely correct. The problem with it is and from a risk communication point of view --

MR. MUBAYI: Yes, the acknowledge the difficulty.

MR. ROSEN: There is a difficulty there.

MR. MUBAYI: Yes. I acknowledge the difficulty. I think we should try to be -- on the next slide I show what we propose that is both consistent with what ICRP did and with certain things that are prevalent that are more or less familiar to NRC staff or various components of NRC staff, those who deal with these things.

So for the 1 rem offsite, we figure an EPA -- you know, PAG, protective action guideline, and we run around trying to make sure that we have nothing above 1 rem. And there are many stories one can tell about, you know, certain things.

At 25 rem we trigger this abnormal occurrence reporting, and that is roughly also the range in which you can start getting a higher -- the risk for cancer induction goes up by roughly a factor of two above that range.

MR. ROSEN: Vinod, is that the right terminology, abnormal occurrence or is it ENO?

MR. MUBAYI: No.

MR. ROSEN: Extraordinary --

MR. MUBAYI: That's a different terminology. That term brought that we've had of about six months of discussion. AO is the right terminology here because it's one part of the regulations for abnormal --

MR. KING: AO is not in the regulations. It was a policy statements that concerns what an abnormal occurrence is, and that has to be reported to Congress. And 25 rem is the one of trigger values for that. And then there's ENO, which is in the regulations and it has a 20 rem value.

MR. MUBAYI: ENO has 20 rem and 30 rem. There are two different things for ENO criteria in the regulation itself. But the 25 is the AO.

DR. WALLIS: Latent cancers, where do you stop there when you --

MR. MUBAYI: Latent cancers would go all the way -- you have a chance of --

DR. WALLIS: All the way down to zero

rem?

MR. MUBAYI: Yes. Under linear --

DR. WALLIS: So it's an interval of the whole curve?

MR. MUBAYI: That is correct. But below 100 millirem, we're saying that's part of normal operation.

MR. ROSEN: Or life.

MR. MUBAYI: Or life. Well, yes, of course part of normal life because we get 300 millirem from living on plant earth. But I think the way in which this is interpreted, this is about background.

MR. ROSEN: ACRS members get more than 300 because we're in the airplanes all the time.

MR. MUBAYI: You fly more regularly and you probably meet in Denver more often.

CHAIRMAN KRESS: We attract radiation.

MR. MUBAYI: Yes.

Now, part of this construction also is that we do want to be consistent with the integrals. So if you see the next slide, which is our curve based on these proposals --

CHAIRMAN KRESS: I have some comments I'd like to make on this slide.

MR. MUBAYI: Sure.

CHAIRMAN KRESS: First place, I applaud you for this consistency. I think that's really a goal to get to. That's no reason that this has to be stair-stepped.

MR. MUBAYI: Has to be?

CHAIRMAN KRESS: Stair-stepped. It can be a continuous curve, and I think it should be.

MR. MUBAYI: Oh, stair-stepped.

MS. DROUIN: Tom, I just have to point out that last time we had it as the curve, and you said we didn't have to have it as a curve, we could consider a stair-step.

CHAIRMAN KRESS: No, no. I wouldn't have said that.

MS. DROUIN: And we were just responding to you.

CHAIRMAN KRESS: No, I would make it a continuous curve.

DR. SHACK: It is a continuous curve.

CHAIRMAN KRESS: Okay. Step-wise continuous, I understand that.

MR. ROSEN: Mary, I also think you should understand is you can't win.

MS. DROUIN: I really understand that.

CHAIRMAN KRESS: But I got two other points that I can make. One, this is an area where I would have three regions. I would have a tolerable, acceptable and unacceptable. And I would make note that the curve as drawn is a risk adverse curve because, you know waned to --

MR. MUBAYI: Correct.

CHAIRMAN KRESS: Your frequency down more --

MR. MUBAYI: Right.

CHAIRMAN KRESS: So you need to acknowledge that that's what you're doing. That you're having a risk adverse.

MR. MUBAYI: Right.

CHAIRMAN KRESS: Which is all right with me. I don't mind.

MR. MUBAYI: Right. It's not risk neutral above, you know --

MR. BLEY: I think one middle point on that, if I could. You know, even in WASH-1400 although they did that, they acknowledged that it has to go that way some even if you want to be constant risk because as the casualties go up, you overload local facilities and all that sort of thing.

CHAIRMAN KRESS: Certainly. But if you were to express the consequences in dollars instead of dose, it would be. You could do it.

But the other comment I wanted to make on this is that I agree that starting out here at the higher level with the dose to be consistent with the safety goal QHOs and these other lower levels is a good idea, but once again now we're back into the realm of level 3 site specifics, population specifics meteorology. And if you wanted to deal with design, you've got to come up with something that's a surrogate.

MR. KING: We're getting to that.

CHAIRMAN KRESS: I know, and I don't like your surrogates.

MR. KING: Oh.

CHAIRMAN KRESS: But what I was saying--

MS. DROUIN: Well, what was the accusation?

CHAIRMAN KRESS: But what I wanted to throw out here, a good surrogate for this curve could be had if instead of dose, you have curies released and curies would have to be specific to specific isotopes, I think.

MR. MUBAYI: Right.

CHAIRMAN KRESS: Like iodine and cesium. You might be able to -- since it's iodine and cesium, you might be able to relate those to the other things some way.

MR. MUBAYI: But even then you can't get away from the meteorology.

CHAIRMAN KRESS: Oh, yes you could. I'm talking about curies released. Now, you can't get away from meteorology, but you can do something like they did to get a LERF. You know, the LERF we got, it was supposed to be a surrogate for the prompt fatality QHO.

MR. MUBAYI: Right.

CHAIRMAN KRESS: And, of course, you had to have meteorology -- you can't ever get away form that.

MR. MUBAYI: Right.

CHAIRMAN KRESS: But as a surrogate you might be able to come up with a curies on the bottom line that would encompass sites on an acceptable way. And then you could deal with the sites that don't meet the thing you derived it from and by using separate citing criteria. You have another room for citing criteria I think to deal with that.

MR. MUBAYI: Yes. I think you can do

what you're --

CHAIRMAN KRESS: But that's what I would look for as a surrogate.

MR. MUBAYI: But you can only do that if you do specify some sort of a site like, you know, when we were trying to define large release back in the '80s and early '90s.

CHAIRMAN KRESS: Yes. I understand.

MR. MUBAYI: We went this whole --

CHAIRMAN KRESS: I would do it just like we did before, I would start with all the sites we have now and back calculate curies that would give you the QHO --

MR. MUBAYI: We have that answer because we did that in the early '90s several times. Yes.

CHAIRMAN KRESS: Right. And then you could replace this curve with curies that encompasses most of those.

MR. MUBAYI: We have an answer equivalent to iodine-131.

CHAIRMAN KRESS: Yes, and that's what I would use.

MR. MUBAYI: And then you could retrofit your equivalent iodine calculation to any --

CHAIRMAN KRESS: And then you have a

curve that's only for the designer. Because he doesn't have to worry about his site at that point. He just worries about his design.

MR. KING: That's one way to make a surrogate.

CHAIRMAN KRESS: Yes.

MR. KING: And we're proposing another way.

CHAIRMAN KRESS: Yes, and we'll get to that in a minute.

MR. MUBAYI: Yes.

DR. WALLIS: I have a fundamental question for you. I have a new reactor, right. And by doing all the -- I can possibly do, I am predicting there's only one accident possible. This accident releases 10 rem or gives a 10 rem dose and the frequency is 10 minus 3. It's one spike. How does this relate to this continuous curve? Isn't it acceptable? I mean integrals fine, except it's peak is above your curve, but integral is fine.

MR. KING: It's not going to meet the design basis accident criteria.

DR. WALLIS: No, but isn't it acceptable.

MR. KING: Not if it doesn't meet --

DR. WALLIS: It doesn't kill anybody. And it doesn't create anymore cancers than a lot of accidents in another reactor would.

CHAIRMAN KRESS: It's probably not acceptable because --

DR. WALLIS: Why not?

CHAIRMAN KRESS: -- you're talking about a research reactor at a university, I think. But it's probably not acceptable.

DR. WALLIS: I'm talking about academic reactor, right. I understand that.

CHAIRMAN KRESS: Right.

DR. WALLIS: But do you see the problem? Accidents are sort of a point in something.

MR. MUBAYI: Right.

DR. WALLIS: They're not a continuous curve.

MR. MUBAYI: Right. Exactly.

DR. WALLIS: And you have a reactor which has a lot of possible accidents.

MR. MUBAYI: Right.

DR. WALLIS: And then it smears all over the curve. Another one which is a wonderful design only allows one or two kinds of accidents. How are you going to handle that?

MR. KING: Well, under our scheme we look at it both ways. You look at the integrated risk, which may be okay.

DR. WALLIS: Which would be fine.

MR. KING: But there's also a set of a process for selecting some design --

DR. WALLIS: Okay. Well, all I do is I have 10 rem and I have a spike which goes above your curve. I say, okay, there's some uncertainty with it so I smear it out and it falls under the curve. I don't understand how you impute it.

I started out by uncertainty and make it really nice and flat and low and it looks beautiful.

MR. LEHNER: I think as we mentioned earlier, this curve is not necessarily the only way you could --

DR. WALLIS: It's going to be a tool. I had thought this was a fundamental tool you're going to use for new reactors.

MR. KING: Yes. Now, admittedly, you know if you're slightly outside that's one thing. But your spike is a an order of magnitude outside.

DR. WALLIS: And all I need do is make it uncertain and I can smear it out and make the spike the maximum less and integral more.

MR. MUBAYI: Yes. If you have a delta function at say 10 rem --

DR. WALLIS: Right.

MR. MUBAYI: -- and I interpret the delta function in a slightly charitable sense by spreading it out a little bit --

DR. WALLIS: Then it's fine.

MR. MUBAYI: -- you will meet it because in that sense --

DR. WALLIS: Yes. I have just a few skyscrapers --

MR. MUBAYI: Right.

DR. WALLIS: -- and you're looking --

MR. MUBAYI: But if you have a few skyscrapers and you put your uncertainty on them and then you have to have a very good out --

DR. WALLIS: You need a lot of uncertainty.

MR. MUBAYI: What?

DR. WALLIS: You need a lot of uncertainty.

MR. MUBAYI: Right. And if you have a very good argument for why those skyscrapers, which then goes back to your PRA. So I think you'd have to work pretty hard to show.

DR. WALLIS: No.

MR. MUBAYI: And, in fact, the reactor you probably end up designing I think would be pretty difficult to demonstrate that. And if you have a spike that's in the deterministic or in the higher dose region, then of course we -- you know, it would --

DR. WALLIS: It's conceivable. I mean, nothing happens unless an operator makes one mistake. And in that case --

MR. MUBAYI: Yes. If it happens, then you're -- if you're above 5E-7 for any acute fatality, that'll rule it out.

DR. WALLIS: Well, I guess we'll get to that. I just don't quite understand how you implement this when you have these extreme accident.

CHAIRMAN KRESS: Well, let's say you had one accident sequence like you've postulated. And it was to release 10 rems and it did so at a frequency of 10 to the minus three.

DR. WALLIS: Well 10 rem is a dose, too, isn't it?

CHAIRMAN KRESS: Yes. Yes. It's a dose of 10 --

DR. WALLIS: And 10 the minus 3.

CHAIRMAN KRESS: What you have a point. You have one point up there and that represents the whole curve.

DR. WALLIS: The integral is zero.

CHAIRMAN KRESS: That's all right. But it does not meet the criteria.

DR. WALLIS: Why not?

CHAIRMAN KRESS: Because you don't want to have a reactor sitting out there releasing at that frequency at that --

DR. SHACK: But the QHO is not the only goal the --

CHAIRMAN KRESS: No, that's the goal. So you don't want a reactor out there doing that.

DR. WALLIS: Of course you do. Because it's a point, it has no integral --

MR. ROSEN: There's an analogy in current LBWRs of your case, and that's the hot early midloop in pressurized water reactors. This is a very highly risky evolution, but it's constrained to a very narrow time window, like tens of hours or 20 or 30 or 40 hours.

DR. WALLIS: Okay. Well, suppose I have 50 possible accidents, all of which are 10 to the minus 4 and 10. Is that acceptable?

MR. MUBAYI: You won't meet this.

DR. WALLIS: No, they're clustered around ten. They all come up one sided.

MR. ROSEN: But my point was that the way you deal with that circumstance in current reactors is by compensatory measures and recognizing during that period that during that period you have a very high instantaneous risk and a very low integral risk.

DR. SHACK: Yes. But in your case you're still dealing with the QHO and the severe accident. I mean, Tom's point is that there are other requirements. And, you know, if you don't meet them, you're you're still in trouble now.

CHAIRMAN KRESS: You change that design. That's right.

MR. LEHNER: As a matter of fact, in your case that would have to be a design basis accident, it was the only accident. That would have to be a design basis accident. And in our scheme that would then would have limitations put on it.

DR. WALLIS: I'd like to put it up to 50 rem to take it away from that.

MR. KING: It would still be design basis-- but that's why we've got both risk and --

CHAIRMAN KRESS: If I go for a design basis accident, either you had to be below that curve.

DR. WALLIS: It's always been a puzzle me how you use something like this.

MR. MUBAYI: And it is. That's how the curve is actually partly -- it's constructed that way.

CHAIRMAN KRESS: It is constructed that way in the first place.

MR. MUBAYI: Right.

DR. SHACK: It's not surprising that it turns out that way.

CHAIRMAN KRESS: Yes.

MR. KING: You know, the document leaves the door open for somebody to use a level 3 PRA and show that their plant falls on this curve.

CHAIRMAN KRESS: You're always going to give them that type of building. But, you know, I'm thinking about designing a reactor and, you know, the old thing of separating design from site sort of concept. To do it with curies.

MR. KING: Yes. But we tried to come up with some more design specific surrogates that would get away from having to do a level 3 PRA and separate this on a -- and that's where we start --

CHAIRMAN KRESS: Yes, now my problem with those surrogates is we've got basically two of them. And your regulatory objective is to meet this whole curve. And I'll tell you right now it's impossible to have two surrogates that represent that whole curve.

MR. KING: Well, we have more than two surrogates. We got to account for design basis accident process as a surrogate along with it.

CHAIRMAN KRESS: Okay.

MR. KING: Which is really in there to make sure the upper portion --

CHAIRMAN KRESS: You still can't do it.

MR. KING: Okay.

CHAIRMAN KRESS: Because you've got a --

DR. WALLIS: Well, something is wrong with this curve. I don't understand how we implement it at all. I have 20 large break LOCAs, one which gives me 200, one gives me 300, one is giving me 400, one is giving 500 and 600 -- they're all just below the red line. Are they all acceptable?

CHAIRMAN KRESS: You have to add them up?

DR. WALLIS: No. Well, how do you add them up in this three dimensional picture?

CHAIRMAN KRESS: It's the summation of the frequency --

DR. WALLIS: Well, then --

MR. MUBAYI: Yes, it's the sum of the frequency.

DR. SHACK: You can't put an individual accident on it.

DR. WALLIS: Why not. I'm going to put 50 individual accidents along on that space in the bottom on the right.

MR. MUBAYI: But this is illustrative of the QA. In the actual QA is total risk. So if I have 50 accidents that all lie at that, which each give me 200 rem let's say.

DR. WALLIS: No. They give you 100, 200, 300, 400, 500. They're not added to that one point.

MR. MUBAYI: All right. And they each lie below. But their total frequency has to be added --

DR. WALLIS: Why?

MR. MUBAYI: -- at up to -- because that's what the QA is --

DR. WALLIS: Oh, I see. You use the QA -

-

DR. SHACK: You have a total of this or less?

MR. MUBAYI: This is for events to put events.

DR. WALLIS: Single events.

MR. MUBAYI: Single events, correct. And it's the integral. It's the area under the curve.

DR. WALLIS: So you see what I'm getting at here, I am having 50 events in that right hand thing, it's very different from having one.

MR. MUBAYI: Absolutely.

DR. WALLIS: Okay. The integral is still acceptable.

MR. MUBAYI: And the integral has been calculated. If you look at all the events that fall in the region right from the extreme left hand side.

DR. WALLIS: All right.

MR. MUBAYI: Up to about let's say for the sake of argument, 200 rem is our -- from 200 down to 25 our risk factor is twice the BIER V distractor. Below 25 down to 100 millirem is the BIER V. You take the total area under the curve, you're right at -- you're like 1.9 something times 1E-6 once you add up the area. Everything above that has to be added up and has to be less than 54-7. So if you're already 5E-7 for any fatal accident --

DR. WALLIS: Anything above.

MR. MUBAYI: -- you're not allowed anything else. I mean you're only --

MR. BLEY: Can I try it in just slightly different words?

This frequency isn't the frequency of the particular accident. It's the frequency of all accidents with this consequence or less.

DR. WALLIS: For that consequence or less?

MR. BLEY: For less.

DR. WALLIS: It's accumulative?

MR. BLEY: Yes.

DR. WALLIS: Oh, that makes a difference.

MR. BLEY: Yes, or am I wrong?

DR. WALLIS: It can't be cumulative and go down. It can't be cumulative and go down.

MR. MUBAYI: It's the frequency of events that -- to this type --

CHAIRMAN KRESS: It's complementary cumulative.

MR. MUBAYI: It's the integral gives you

essentially the QHO.

CHAIRMAN KRESS: It's not exactly the integral that gives you the QHO.

MR. MUBAYI: It's the area, I mean.

CHAIRMAN KRESS: No, it's not exactly that either.

DR. WALLIS: No. You can't have an area--

CHAIRMAN KRESS: It has something to do with the slope at the high end of the curve --

MR. MUBAYI: Oh, at the high end. You know, if you could -- as I said, it's risk adverse as somebody -- a very good point. Beyond where you get into determinism is deliberately chosen to be risk adverse.

CHAIRMAN KRESS: Sure.

MR. MUBAYI: And in fact the slope here is not minus one, but you know it's something like minus one .6, something like that.

DR. WALLIS: On the average.

MR. MUBAYI: If you actually draw the -- so the idea is that the higher you go, the more risk adverse, you know, you should be which is our objective. Our safety objective is to really try and prevent high releases. But the only point -- we have to multiple of course by the cancer conversion factor for rem, LCF for rem in order to compare with the --

DR. WALLIS: The only problem I have it seems to assume a kind of continuous accident space which I don't think you have. That's my whole point.

CHAIRMAN KRESS: If you take the whole list of PRA accident sequences --

DR. WALLIS: Then you get something that looks kind of continuous.

CHAIRMAN KRESS: Accident sequences, you would have dots all over --

DR. WALLIS: Oh, I understand that. But present reactors you'd have a more or less continuous thing.

CHAIRMAN KRESS: Yes.

DR. WALLIS: But there may be future designs which are all at one end of this thing.

CHAIRMAN KRESS: That doesn't matter.

DR. WALLIS: Well, I think it might matter to me.

CHAIRMAN KRESS: It might. Yes, you might view that differently, but --

DR. WALLIS: It has no small accident--

CHAIRMAN KRESS: But I want to receive my point. This curve cannot be represented by a two or three QHOs. It's not the integral under the curve. I think you should think about that.

Let's say if you have 2 QA, two of them who have core damage frequency -- let's say this was -- you had a core damage frequency and a prompt failure, you couldn't represent this curve, this curve with those two.

MR. MUBAYI: No. I want to take up the latent cancer curve -

CHAIRMAN KRESS: Latent cancer is related to --

MR. MUBAYI: That's right.

CHAIRMAN KRESS: That is the one thing that is related to the integral.

MR. MUBAYI: The only QHO -- you're right. The only QHO I'm thinking of here is QHO 1 is the risk of prompt fatality, which is --

DR. WALLIS: And you don't care about anything less than a 100.

MR. MUBAYI: Which is all accidents above 200 rem, let's say.

DR. WALLIS: So the rest of the curve is irrelevant?

MR. MUBAYI: Right. No, the rest of the curve is for the latent cancers. The latent cancers is under the linear no threshold are all those -- because we start defining accidents as those that give you a dose bigger than allowed under normal operation, otherwise you know it's not an accident. It's part of normal operations. So those accidents right from .1 to about 200 is QHO 2 is that the latent cancer risk should be less than 2E-6 for, you know, the average individual. So that essentially is the area under this curve when you take the area multiple it by the BIER V appropriate cancer dosage.

CHAIRMAN KRESS: I will agree that the latent cancer is --

MR. MUBAYI: That's all that is meant to represent.

Now, the subsidiary objectives, which is the core damage and the LERF, are derived from the QHO 1 and 2, which is the latent cancer and prompt fatality. And those are subsidiary objectives.

This curve is not supposed to represent those objectives directly. Indirectly we can say that since those subsidiary objectives are, more or less, consistent and the way they were obtained is consistent with the higher objectives, which is the cancers and the prompt fatalities, it's only an indirect way of referencing that. It's not a direct reference.

CHAIRMAN KRESS: Well, my point is if you had this curve expressed as frequency versus curies, that in itself is a surrogate and it comes out of the PRA and it comes out of design. And you no longer leave these others. And they're confusing because let's say you're trying to relate to prompt fatality, you can't relate it to this curve. It's very difficult to write the prompt fatality QHO to this curve.

If you had a core damage frequency, it can be related because the cumulative -- in some sense the cumulative of the -- the complimentary cumulative curve that you get sort of asymptotes to the core damage frequency, but it's an asymptote. And then you have -- you have a real problem relating this curve to the curve surrogates, the core damage frequency or the prompt fatality. It's different to do it. But now we have a new surrogate. It's the frequency versus curies and that's a design specific, it's a good surrogate. It gets it away from the site and you don't have to --

DR. WALLIS: You're going to rewrite the

fundamental principle of QHOs by doing this curve. This is a reflection of the QHO.

CHAIRMAN KRESS: Oh, no. Oh, no, no. It's consistent with the QHOs.

DR. WALLIS: Well, the area is but there are many ways to get the same area.

CHAIRMAN KRESS: I'm also going to have -- I'm going to require the designs to meet this. I'm going to have three regions.

DR. WALLIS: Well, I have that problem, too.

CHAIRMAN KRESS: But I'm also going to require, since I don't know how to assess this frequency consequence very well because of the uncertainties, I'm going to also have a set of design basis accidents which are related to this in a sense that I'm going to pick out every accident type for this reactor design, and I'm going to say that for each of these types I'm going to pick out the sequence associated with that type for that design that gives me the highest dose or highest number of curies, and then we'll say that is a design basis accident and I'm going to limit it so that it has some very stringent -- I would treat it just like the curve design basis. It has stringent requirements on it and it has to meet the acceptance criteria. It's pretty stringent.

With those two combinations you're assured of a defense-in-depth and you're finally assured of meeting QHOs or you got this curve from the QHOs, actually.

DR. WALLIS: Show me. I don't understand it. If you take something like the failure in the reactor and try to apply this curve, I don't know how you do it. You've got to evaluate specific accidents and they may be delta functions, they may be a lot of narrow spikes and I don't know how you apply this to that. I don't know -- how you make a decision.

CHAIRMAN KRESS: Each accident sequence, and you bin these. Each accident sequence bin is a point on this curve.

MR. KING: They could analyze the design and they could come up with a curve for their design and you see how it falls in relation --

DR. WALLIS: But they don't have a curve. They just have -- lot of just discontinuous bumps.

MR. KING: Given all this discussion, we're proposing not to use such a curve.

DR. WALLIS: Okay. Okay. That's good. Thank you.

MR. KING: But to lay out the concept at a very high level of what we're trying to achieve, we generated a curve and we left the door open if somebody wanted to actually do a level 3 PRA and try and use it, they can do that. But we're suggesting let's take a step down and develop some surrogates --

DR. WALLIS: Surrogates for this curve?

MR. KING: Surrogates for the QHOs.

DR. WALLIS: Oh, for the QHOs.

MR. KING: And some design basis accidents to keep it a risk-informed and also try to implement the left hand part of this curve, in other words we want to make sure that frequent accidents don't lead to large releases.

DR. WALLIS: How do you define these DBAs? You have to analyze all accidents and then you find some were in some regions and therefore they will be DBAs? You have to analyze them all before you know which fall in which region.

MR. KING: What we're proposing is, and we'll get to it, is a set of criteria that categorize accident sequences by frequency. The more frequently --

DR. WALLIS: But you don't know how frequent they are until you analyze them.

MR. KING: Yes, you have to do the PRA.

DR. WALLIS: So you have to analyze them anyway?

MR. KING: Yes. I mean, either way you got to do the PRA. But instead of just deterministically saying, you know, these are design basis accidents, we're selecting them from the PRA based upon their frequency. And in a given frequency range you pick those ones that you have the highest consequence, in other words release the most material to the environment or get closest to core damage but it's likely a lot of these are not going to actually go to core damage, certainly in the more frequent range.

MR. ROSEN: Do you think that's clear in your document that you do the PRA to pick the design basis accidents? That's a key point and it's a good way to do it.

CHAIRMAN KRESS: I would also add another --

MR. KING: If it's not clear, we need to make it clear.

CHAIRMAN KRESS: Yes. I would add another criteria to that selection, that would be I would have one of each accident type.

MR. KING: Type being LOCA versus loss of electric power versus something else?

CHAIRMAN KRESS: Yes. I mean, I wouldn't just pick the ones that were the high --

DR. WALLIS: The PRA is quite site specific.

CHAIRMAN KRESS: It's because of the uncertainties, I would have one of each type.

DR. WALLIS: But I don't know quite how you do that.

MR. KING: Each design would have a different set of design basis accidents based upon its PRA and its design.

DR. WALLIS: I don't think any design basis accidents at all. If you've done the PRA and you've analyzed all the accidents, then you've done the job. You don't need to now go back and classify some of them as design basis.

MR. KING: Yes, you do.

DR. WALLIS: Why? What's achieved by this?

MR. KING: There's two reasons. One is

to make sure that for the more frequent events you don't have large releases. And like you say, there are different shapes of this curve that you could have the same area underneath.

The second reason is you need to have something that ties to Part 100, the siting criteria. And you need to select those accidents that you're going to analyze for siting purposes.

DR. WALLIS: But you must have already analyzed them if they're in the PRA.

MR. KING: So which ones are you going to pick for siting?

DR. WALLIS: The whole bloody lot.

MR. KING: Design basis accidents --

DR. WALLIS: They do characterize the plant.

MR. KING: But you still need to pick some that you're going to compare to the Part 100 base criteria.

DR. WALLIS: Why -- they represent the accident characteristics of the plant.

MR. ROSEN: If they all meet Part 100, what difference does it make?

MR. KING: Well, if they don't meet Part 100 it doesn't make any difference. But chances are they're not all going to meet Part 100. You know, 10 to the minus 6 events probably aren't even going to meet Part 100. Certainly not.

DR. SHACK: That's one hell of a plant.

CHAIRMAN KRESS: Yes, one hell of a plant.

MR. KING: But those are the two reasons we still wanted to stick with design basis accidents.

DR. WALLIS: Well, I think you ought to think seriously on whether you really need design basis accident concept at all.

CHAIRMAN KRESS: Well, my take on that was that design basis accidents are sort of defense-in-depth. And if you had the perfect knowledge that Steve talks about, you could almost do what you said. But I just think we have to face up to the fact for new reactor designs of unknown experience with, we don't have a good idea what the frequencies of certain kinds of accident. We don't even know if we've identified all the accidents. That you're going to be faced with an extremely difficult time of assessing the uncertainties.

And I would meet the QHOs with some confidence level, which means you need some uncertainties there. But you're just never going to be able to make that calculation real definitive and you need defense-in-depth.

Now, they've got several types of defense-in-depth here. One of them is they're addressing different strategies and making sure that the attention is given to them. But I think design basis accidents is way to have a defense-in-depth.

MR. KING: That's right.

CHAIRMAN KRESS: And what you do there is you pick accidents of every type you think this thing can have, so you pick the accident in that type, the sequence in that type that your PRA tells you have the greatest sequence, and you say that's my design basis accident and I'm going to make them design the reactor that that meets some stringent acceptance criteria.

DR. WALLIS: More stringent.

CHAIRMAN KRESS: That one. Yes. And here I have a set of design basis accidents I can deal with and I can treat them just like design basis accidents are now, and it's a way to deal with the uncertainties and it's a defense-in-depth, and you can do things with it that you normally do with design basis accident. It's a very useful concept.

DR. WALLIS: Design base accidents are supposed to have no consequences, aren't they?

CHAIRMAN KRESS: That's right.

DR. WALLIS: What you do is you look at these and you find that there's a consequence, which is a dose of 20 rem or something. That's the worst I've got in that region. I call that design basis. Now I have to go back and redesign the plant so that it has no consequences?

MR. KING: No, no. Design basis accidents have consequences.

DR. WALLIS: I thought they were supposed to have no consequences?

MR. KING: No.

MR. BLEY: They just --

DR. WALLIS: -- space, they have no consequences --

MR. KING: No. They can go up to 25 rem offsite.

MR. BLEY: No. I guess one of the things certainly, we've talked about taking the ones with the highest consequence. We've also said you need to look and see if there's something that except for maybe one more failure, something that's close could have much higher consequence.

CHAIRMAN KRESS: Well, that could be.

MR. BLEY: And pick some of those. Now one step away from a very bad accident.

CHAIRMAN KRESS: Yes, I hadn't thought through exactly what I would do with that, but I think you're on the right track.

MR. ROSEN: Well, it was my goal in these structural things we're talking about is to get to the point were we would not have DBAs. And that was you're required to do that, it was perfect knowledge, no uncertainty. And because you always irreducibly have model uncertainty, completeness uncertainty it's a piece of model uncertainty -- because you irreducibly have some completeness uncertainty and you don't know what you don't know, you're forced back to DBAs in the end. And it seems to me that's the only irreducible hard rock in the middle of this thing. You cannot get around the fact that you don't know what you don't know. You have completeness uncertainty. And that is the fundamental reason for DBAs, having DBAs. And then there are some other things that, yes, it turned out it's nice to have DBAs for. But it's the completeness uncertainty that drives you.

DR. SHACK: But it isn't clear to me

that the process is going to be absolutely convergent. That is, if I have my PRA, I have to have designed the plant. I then come up with this DBA, and to address my model uncertainty and all other sorts of model uncertainty, I add additional requirements and conservatisms to this DBA. And I may well go back and then find my plant does no longer meet the DBA, so I have to redesign my plant.

DR. WALLIS: Something else which is wrong. Right.

CHAIRMAN KRESS: Yes. It would have to be a iterative process.

MR. KING: It's an iterative process.

DR. SHACK: And then I do the PRA over again and I go through this whole process.

CHAIRMAN KRESS: Yes.

DR. WALLIS: Then something else becomes the DBA. You'll have disclosure that way.

MS. DROUIN: Your DBAs will change over time with this approach.

DR. WALLIS: With this approach.

DR. SHACK: But all designs have spiral kinds of iterative process.

MR. BLEY: But it's very tractable.

DR. SHACK: Normally you're spiraling

towards an objective that remains fixed. In this case the objective is also a sort of a floating target.

MR. BLEY: It could be, but I suspect --

DR. SHACK: It may converge very rapidly, yes.

MR. BLEY: Yes, and you'd start with your guesses where they were, and you'd probably be right on most of those.

MR. ROSEN: I think rather than thinking of it as a problem, I think of it as a strength of the process is that one can use the PRA, modern PRAs and modern machines to do the calculations as an iterative tool that gets you to that convergence. To the point where you can add systems and see what they do and they don't change anything, you know that system doesn't help you. You don't need it.

MR. BLEY: I suspect if it doesn't converge, you've got some real --

CHAIRMAN KRESS: Design problems.

MR. BLEY: Yes. Nasty holes in your knowledge.

DR. SHACK: But if I've left sequences out of my PRA, I don't see how my design basis covers me.

MS. DROUIN: Your design basis will not do that. That's why you have the protective strategies. Because the protective strategies, the four that we have, those are trying to capture your completeness issue of covering what you don't know. Because you're absolutely right. I mean if your PRA doesn't cover something, to uncover it in the design basis accident ain't going to help you.

CHAIRMAN KRESS: Ain't going to help you at all.

MS. DROUIN: It isn't going to help you.

DR. WALLIS: You need some exemplification here. I mean, I read this document, I was very impressed with it and all, and I said gee wiz, it looks -- I don't see how it is applied, how it works. And then I can start thinking of things that when I try to use this and I get into trouble. And I guess this is one of your next steps is to show with exemplification look at some extreme cases where the DBAs are all bunched up together or something to illustrate how you would use this. Then I think I would be much more convinced.

MS. DROUIN: I have the feeling we're not going to make you happy today. And the reason is --

DR. WALLIS: Well, I'm very happy with the progress you've made.

MS. DROUIN: Okay. Well, I'll take that compliment. But chapter 6 is going to be a critical chapter in here because it does show in essence how do you implement this stuff, how are we taking these concepts that we have explained in chapter 3, chapter 4, chapter 5 that we haven't gotten to yet and bring it all together and start writing requirements.

CHAIRMAN KRESS: Are you going to pick a specific design to show how that would be implemented?

MS. DROUIN: No. These are technology-neutral.

MR. KING: But if you look at chapter 6, one of the things, DOE's very interested in this. And one of the things they've committed to do with us is take their VTHR design they're thinking of for Idaho and test it against this.

CHAIRMAN KRESS: Good idea.

MR. KING: How does it work?

CHAIRMAN KRESS: You know what I'd do also --

DR. WALLIS: And you're going to do the Canadian one, too.

CHAIRMAN KRESS: -- I would take a current LWR and test it also.

MR. BLEY: Well, we thought about that, too.

CHAIRMAN KRESS: See how that passes.

MR. BLEY: We've got a lot. It's a lot of work.

MS. DROUIN: We were going to do that, too.

But the only reason I was saying is that we wouldn't make you happy is because chapter 6 is not totally done. We're in the early stages of chapter 6 still. So we still have a lot more thinking. As you saw, you should have seen a lot of holes in it.

DR. WALLIS: I know that -- is really at stake here.

MS. DROUIN: Absolutely it is.

MR. LEHNER: Yes. I want to make one more comment about design basis accident, if I may.

MS. DROUIN: Right.

MR. LEHNER: We're saying that they're not just going to change during the design the plant, but they can actually change during the operation of the plant.

MS. DROUIN: Right.

DR. SHACK: Well, that I can understand. That's certainly one way to discover a new sequence.

MR. LEHNER: Exactly. Yes.

DR. SHACK: A little late, but --

DR. WALLIS: You know a design basis accident when you had one.

MS. DROUIN: But I think that's a strength on making this fluid. Because, you know, as you learn and you design better and you operate betters, well then you've gotten those and now you've dealing with these new ones and you don't have the -- I think our current structure makes it very difficult for us, you know, because we think we knew everything and we're trying to set up a structure that's flexible that recognizes that we don't know everything and we might come up against new accidents and new scenarios that you're going to have to deal with.

MR. ROSEN: It just shows we're learning. That we finally got to the stage where we're smart enough to acknowledge we don't know everything.

MS. DROUIN: That's right.

CHAIRMAN KRESS: Even with LWRs you're adding design basis accidents --

MR. ROSEN: Of course. ATLAS.

CHAIRMAN KRESS: So it's not unprecedented.

MR. KING: We don't call them design basis accidents, though.

MR. ROSEN: They would have been called that if they had been identified in the front end.

DR. WALLIS: Mr. Chairman, can we go on to a new subject --

MS. DROUIN: But it also implies that you go through and put in a new regulations. It's a very long process but this, hopefully, will circumvent that.

DR. WALLIS: Tom, it seems to me we're beginning a new chapter. Can we take a break.

CHAIRMAN KRESS: Yes, we're scheduled for a break here. This would be a good point.

I say let's have a 15 minute break, so come back at 20 after 3:00.

(Whereupon, at 3:03 p.m. a recess until 3:24 p.m.)

MR. KING: Slide 24 is where we get into

risk surrogates because we realized that doing a level 3 PRA has a lot of complications and it's fair to focus on design parameters. So what we did was come up with two surrogates; one for accident prevention and on for accident mitigation.

Now, we also took a look at can we claim that these surrogates are good enough to say that they also will protect the environment. Because we don't have any separate goals on environmental protection. So we took a look at that from the standpoint of where do we have anything that talks about the environment in the regulations. And the only place we could find was 10 CFR 140 definition of an extraordinary nuclear occurrence, which has several criteria in there that if exceeded, can trigger people filing a claim under Price-Anderson.

They have a criteria that deals with land contamination in terms of actual curies per square meter. They have one on cost of cleanup that if you get enough contamination it costs more than X dollars to clean it up, then it's an extraordinary nuclear occurrence.

So we took a look at both of those from the standpoint. And if we applied our surrogate risk objectives, one for prevention and one for mitigation, to those 10 CFR 140 criteria, would they give you essentially a equivalent level of protection as we're giving in the public considering the level of public protection as expressed by the QHOs, latent fatality and early fatality.

So the document looks at that two ways. The likelihood of exceeding the contamination levels or the -- which can be converted to dose and it works out that the dose numbers would be about 20 rem per year for the level of contamination if somebody was standing for a year. And we looked at applying the core damage frequency goal of 10 to the minus fifth, which we'll get to here in a minute. If you apply that to those dose levels, then you would meet the latent fatality and the early fatality QHO.

We did the same thing looking at the cost numbers that are in 10 CFR 140. And comparing them to the value of life that is used in regulatory analysis if we took the cleanup costs that are in 10 CFR 140 and multiplied them times the accident prevention and accident mitigation goals that we're proposing --

DR. WALLIS: Well, what is the definition of core damage for something like a molten salt reactor?

CHAIRMAN KRESS: They would have to define -- certainly some sort of release factor.

DR. WALLIS: Yes, we'd go back to LERF or something then.

CHAIRMAN KRESS: No, no.

MR. KING: For core damage --

CHAIRMAN KRESS: You know, I was saying my strategies would be limit release from fuel and limit exposure --

DR. WALLIS: That's better then --

CHAIRMAN KRESS: And you're defining core damage --

DR. WALLIS: You wouldn't talk about damage then.

CHAIRMAN KRESS: -- of the limit on the release of fuel --

MR. KING: But we don't use the word core damage. We use accident prevention recognizing that --

DR. WALLIS: How big an accident?

MR. KING: Well, recognizing that for each of these different technologies the definition of core damage is going to be different. And we were thinking core damage, but core damage may not make much sense for something like a molten salt reactor. And clearly core damage for a gas reactor would be different than a water reactor. So we just used the generic term accident prevention and realized that the definition of that is going to have to be technology-specific. And that's one of the things we pick up in the earlier slide when Mary talked about task 3 where we get into applying some of this on a technology-specific basis, that would be one of the things we'd have to look at.

Well, anyway, back to the protection of the environment. In looking at how we would meet the 10 CFR 140 numbers considering our accident prevention and mitigation goals, it worked out that we could show pretty much equivalent -- protection of the public would be pretty much equivalent to protection of the environment considering dose bases and a value or cost bases.

CHAIRMAN KRESS: I thought that was an excellent analyses. Really good. That was very nice.

MR. KING: So the bottom line is we're not proposing --

CHAIRMAN KRESS: And I also liked this thought of getting time out of it, you know, getting away from large area release because of this. Now you're just talking about --

MR. KING: Large release.

CHAIRMAN KRESS: -- large release.

MR. KING: Whether it's early --

DR. WALLIS: So this is more release, just one, is that what you mean? What's the difference between this one and the next one? If you don't have a core damage definition, that this is a small release, is that what this his?

MR. KING: Under accident prevention are you talking now?

DR. WALLIS: Well, you've got two things. You've got 25 and 25. You've got two levels. One 10 to the minus 5, one 10 to the minus 6. One related to latent fatality, one's early fatality. And what's the difference in terms of measure of release or something? How will you relate to the reactor and the event?

MR. KING: What we're saying is the accident prevention criteria serves as a surrogate for the latent fatality QHOs --

DR. WALLIS: So you have to evaluate the -- it's a surrogate for it?

MR. KING: It's a surrogate for it.

DR. WALLIS: Well then what's it measure

then?

MR. KING: What the measure is if you prevent core damage, you're not going to have basically any release.

DR. WALLIS: So it's a release which is related to or a measure of damage which is somehow related to this QHO?

MR. KING: You start with the QHO.

DR. WALLIS: All right.

MR. KING: That's the value you're trying to meet.

DR. WALLIS: Then you work back?

MR. KING: And you work backwards. And the assumption is that --

DR. WALLIS: To a release? Then it's like a small LERF? Small?

MR. KING: Well, it's basically no release. If there's no core damage, we're making an assumption there's no release.

DR. WALLIS: Then there won't be any latent fatality then?

MR. KING: And there won't be any latent fatalities.

DR. WALLIS: Then it's zero. I don't quite understand.

DR. SHACK: But by setting this core damage frequency at 10 to the minus 5, he assures himself that he's got a modest number of latent -- you know, the consistent number because he --

DR. WALLIS: That's what I thought he meant. But he must mean there is a release then.

MR. KING: No. At 10 to the minus 5 or something more frequent, there's no release.

DR. WALLIS: But then you don't have any latent fatality.

MR. KING: You think of it as a bound on it.

DR. WALLIS: And you can't have one without the other. The QHO says that there has been a release. If you get 10 to the minus 6, you have latent fatality, there must have been a release.

DR. SHACK: That's right.

MR. MUBAYI: I think that the assumption here is that it's analogous to something like a gap release or, you know, what we call iodine spiking or some -- it's some minor release that will give you a very minor amount of dose at the -- you know, beyond the site boundary.

DR. WALLIS: Well maybe you have to define what that release is.

MR. MUBAYI: Yes. The problem is that since we don't have an analog or a goal, I think once we come to specific designs, we may have to look at that.

DR. WALLIS: You want to find out what it is.

MR. MUBAYI: Yes.

DR. WALLIS: And then you'll make a temporary responder to whatever that is?

MR. MUBAYI: Exactly. That's correct.

DR. WALLIS: So you have a much more precise definition of what you mean by what we now call CDF?

MR. KING: Yes. Yes. That's going to be technology-specific. But the idea is if you keep the release very small up to frequencies of 10 to the minus fifth, you're pretty much guaranteed of not exceeding the two times 10 to the minus 6 QHO. Because atmospheric dispersion will take care of limiting the dose to the population around the plant and it doesn't matter what the timing of the release is or the form of the source term, or what the EP assumptions are.

CHAIRMAN KRESS: Well, following up a little bit on Graham's, could you not associate this

10 to the minus 4 with a real release.

MR. KING: You could. Yes, you could.

CHAIRMAN KRESS: You talk about in curies?

MR. KING: You could. Yes, you could.

CHAIRMAN KRESS: And say that's my definition of core damage frequency.

MR. KING: Yes.

CHAIRMAN KRESS: If my cumulative accidents release this much --

MR. KING: Yes.

CHAIRMAN KRESS: -- then I have that --

MR. KING: Yes, you could do that.

CHAIRMAN KRESS: It might be a more consistent --

DR. WALLIS: It's understandable, yes.

MR. KING: And clearly for something like an HGTR that may be the only practicable way to do it, whereas for a water reactor you can talk about water levels or clad temperatures.

CHAIRMAN KRESS: Yes, you can do other things.

MR. KING: Other things, yes.

DR. SHACK: If you have surrogates for the --

MR. KING: Surrogates for the surrogates. Okay.

And you on to slide 26, we basically did the same thing for large release frequency. Again, it's not large early release, it's large release. It doesn't matter what time during the course of the accident it occurs.

CHAIRMAN KRESS: I really think it's a really good idea.

MR. KING: And working backward from the early fatality QHO, if you don't have a big release from the reactor, more frequent than 10 to the minus 6, you're not going to exceed the early fatality QHA because atmospheric dispersion is going to take care of it.

DR. WALLIS: Now would this have a curie number 2 with it?

MR. KING: Well, you could. We suggested the magnitudes that associated with one or more early fatalities offsite. But you could convert that to a curie number. You could do the same thing.

CHAIRMAN KRESS: But here you meet the QHO without any evaluation or anything.

MR. KING: Right. And we purposely said

no dependence upon EP, because some of these plants would like that. So we said okay if they want that, what kind of accident prevention and accident mitigation criteria are we going to have to come up with.

CHAIRMAN KRESS: Yes, they'd have to come in and propose something to you on that.

MR. KING: And then the last bullet on here, you know, leaves the door open. If they don't like those numbers, they can propose something and take credit for EP or anything else they want to take credit for.

DR. WALLIS: So this large release is associated with one or more early fatalities offsite.

MR. KING: Yes.

DR. WALLIS: And that occur with a frequency less than one in a million per year.

MR. KING: Right.

DR. WALLIS: How about the release that's associated with the million fatalities offsite? Would that have the same reliable frequency?

MR. KING: No.

DR. WALLIS: Why? It seems it does.

MR. KING: A million fatalities offsite?

DR. WALLIS: It's still the same criterion, isn't it?

MR. KING: Well in theory with the way the QHOs are stated and calculated and assuming that the atmospheric dispersion is within the bounds of what we've assumed, you know the wind only goes in one direction and spreads out about over a one-tenth sector around the plant, you could basically -- everybody in that sector could have an early fatality--

DR. WALLIS: Well then they could always that criterion in an integral of the large release is bigger than a certain number of curies, integral of the releases and their probabilities so that there's measure -- it takes into account that the small large releases and the big large releases and weights them in some way.

MR. MUBAYI: No. I think the idea here is to be consistent with the QHO. The QHO measures average individual risk and the Commission tells us how to define the average for the reactor. For the current generation of reactors it's the area which is one mile radius around the plant.

DR. WALLIS: Yes. But the release of a

million more curies creates more fatalities.

CHAIRMAN KRESS: Yes.

MR. MUBAYI: Well, yes, you could have. But it's frequency, it still shouldn't exceed the QHO. So if you have a release that will -- you make the average individual risk of early fatality, whether it kills one person or a 100, if it will kill the 100 people in the same area, it'll go above the --

DR. WALLIS: Yes, but your frequency doesn't get into account. You're one to the 10 to the minus 6 doesn't take it into account.

CHAIRMAN KRESS: But what Dr. Willis is hitting on is a recommendation that we once had as a committee that said the safety goals are incomplete. They need goals on land contamination and they need goals on societal risk, which is total member deaths we made that recommendation. It got completely thrown out by the Commissioners.

And what he's asking for, I think, if you look at what he's he saying is another goal on total deaths, societal --

DR. WALLIS: Well from the beginning of being on this Committee I could never understand why a LERF was a LERF whether it kills one person or a million people, it's still called a LERF.

CHAIRMAN KRESS: Well, because of this one way they wrote the safety goals.

DR. WALLIS: That's ridiculous.

MR. BLEY: In fact, the original safety goal recommendation from this Committee when Dave was here had a societal goal in it. And it disappeared.

CHAIRMAN KRESS: Yes, and I still think it was a mistake to get him out.

But, you know, you got what you got. And they don't deal with this total -- I mean you could kill -- as long as it meets this individual risk criteria, it doesn't matter whether it's a 100 deaths or 1,000 deaths.

DR. WALLIS: If there were a million people standing near the reactor, it doesn't make a difference whether there was one person or a million.

CHAIRMAN KRESS: Yes. Now there's an attempt to create a control that with a siting criteria. There are things about the siting criteria that help control --

DR. WALLIS: But there's nothing here about the magnitude of the release then, is there?

Large releases are large release whether it's enough to kill one person or a million people.

CHAIRMAN KRESS: Well, you could only release so much because there's only so much in there.

DR. WALLIS: Yes, I mean there's obviously a difference.

DR. RANSOM: Well, doesn't the probability occurrence drop off as the magnitude of the release increases or --

CHAIRMAN KRESS: Well, for LWRs it certainly does.

DR. WALLIS: Yes, but it's not figured out here. There's just one criteria. It's not a criterion that falls of or anything.

CHAIRMAN KRESS: That's why I'm saying this one criteria can't get that cumulative curve. That's one reason I say it can't do it.

DR. WALLIS: So it's like saying there's one in a million chance tolerable that a bomb goes off at a baseball game and whether it kills 10 people or 10,000 people is irrelevant.

CHAIRMAN KRESS: In wouldn't be irrelevant in my F-C curve because the frequency keeps dropping of.

DR. WALLIS: Well, in the rational world it might not be.

CHAIRMAN KRESS: Yes. That's why I like the F-C curve. It automatically takes care of your problem.

DR. WALLIS: Well, I don't know it's my problem; I think it's society's problem.

CHAIRMAN KRESS: Now, you know what they have is the safety goals and the safety goal policy statement. And they're trying to stay within those confines because that's what the Commissioners down through the years or the Commission has come up with.

I was trying to sneak in the back door and say let's use an F-C curve and now redefine the safety goals and made them a little more rational to my mind. But, you know, it's sneaking in the back door. I recognize what I'm doing.

DR. WALLIS: And individual who is looking at this doesn't care about the risk to other people, just about --

CHAIRMAN KRESS: Yes. It's like saying I don't care if a million people die as long as I don't.

DR. SHACK: Although I think it's true

that if you look at actual F-C curves, at least for LWRs, the way they behave at large frequency --

CHAIRMAN KRESS: The actual behavior of the reactors do drop down.

DR. WALLIS: But that's not reflected in the --

CHAIRMAN KRESS: Yes, it's not in the acceptance criteria.

DR. WALLIS: Yes.

CHAIRMAN KRESS: But by controlling large releases to this frequency and using design basis accidents, you kind of get that.

DR. WALLIS: It's a surrogate for what --

CHAIRMAN KRESS: Yes, you're trying to get that.

MR. KING: In the extreme the safety goal if you have a large release frequency that's less than five times 10 to the minus 7, you could kill everybody and still meet the safety goal.

DR. WALLIS: So you're saying that if there's a one in a million chance of any bomb going off --

CHAIRMAN KRESS: Because it ain't going to happen.

DR. WALLIS: -- at a baseball game, then the chance of a big bomb going off is going to smaller than that is what you're sort of saying?

MR. MUBAYI: Well, you sort of, if you're thinking about a meteor strike idea, which is 10 to the minus 8 --

DR. WALLIS: No. I think you're saying if you limit any bomb, then automatically the big bomb is going to be less likely; that's what you're saying. Is that okay?

CHAIRMAN KRESS: That's a good way to look at it.

MR. ROSEN: Now what can you say, Tom, to give me some comfort about this sector distance? Isn't there to a degree controlled by a circumstance in which you have a Pasquel say F where it's very stable but it's meandering. Wind direction changes slightly over time and it takes one, two, three sectors. Is there a rigorous demonstration that that assumption, which is I think critical to this is true?

MR. MUBAYI: Well, let me say it's not rigorous in the sense of mathematical. Even the Pasquel categories and are stability and etcetera. It's just based on running a consequence goal at various sites, maybe a 1,000 or 2,000 or 3,000 times and then trying to distill this statistically. And actually the idea that about wind persistence, the fact that it moves the -- it depends on the duration of the release. If you have Chernobyl, all the bets are off if you're releasing over 12 days or over 10 days, you know, you can go in any direction.

DR. WALLIS: You can straight up. If you have a good plume, you don't need anybody near the site.

MR. MUBAYI: Yes.

DR. WALLIS: And you don't kill anybody.

MR. MUBAYI: And Chernobyl was good from the standpoint that, you know, it was very energetic so you injected -- the dilution was huge. If you had a ground level, you would have had a real problem in the nearby community.

CHAIRMAN KRESS: Especially towards Kiev.

MR. MUBAYI: Yes. So based on the ground level, based on what we spent about two years trying to develop what we called an 80th percentile site, that from the standpoint of atmospheric stability -- rain in the sample, that's the most crucial thing that affects your early fatality because rain over a populated area at the time the plume is released and especially within one or two miles can give you really dramatically higher because, you know, you're dumping the entire amount on a small --

DR. WALLIS: Unless it's enough rain.

MR. MUBAYI: Yes. So you've got all these different factors. And if you run these codes many, many times you get some feel for these averages. So it's no, it's not mathematical. I can be called experiential I guess, at best, you now distilling from doing some calculation, you know, hundreds of times over.

MR. KING: I've gotten a note to move things along because we do want to get to defense-in-depth.

CHAIRMAN KRESS: Okay. Let's move it on.

MR. KING: Integrated risk. We've talked about that in the past. We got your letter.

DR. WALLIS: You have no conclusion on that yet?

MR. KING: No conclusion on your letter.

DR. SHACK: Well, I like this principle

there. They're important regardless of reactor power load. At least half the Committee agrees with that.

MR. KING: Okay. All right. Let's move on to slide 29. Let's talk about design construction and operational objectives quickly.

DR. WALLIS: That's the rest of chapter 4.

MR. KING: Yes, this is the rest of chapter 4.

We are recommending some frequency criteria to categorize initiating events and event sequences. These would be used for a couple of purposes. One to define what needs to be considered for licensing purposes, how far down you need to go in frequency space. But also the frequent and infrequent events sequences would be looked at for defining anticipated operational occurrences and design basis accidents that would be the deterministic part of these scheme.

If we go on to slide 30, in fact we had talked about this earlier. What we would do is take the frequent and infrequent categories and pick from those events that lead to the highest consequences and/or conditionally get closet to core damage and call those AOOs or DBAs. Again, we're doing that because: (1) we want to make sure that the high frequency events have lower consequences and we need something to link to Part 100, the siting criteria.

For those things that we call AOOs, going over to slide 31, we're proposing some deterministic slide criteria that are shown on slide 31. For AOOs we're saying that they should not exceed 100 mrem at the exlusionary boundary. That's consist with the Part 20 guidelines for exposure to the public. And they should also not lead to any loss of core cooling or fuel damage. AOOs today we don't allow fuel damage. The plants should be able to restart from those and not have to worry about replacing fuel or equipment.

And that they would maintain at least two barriers to the uncontrolled release of radioactive materials. In other words --

DR. WALLIS: It sounds so circular to me that AOOs are selected to be on this curve so that they don't exceed 100 mrem, and then you have to treat them as EAB. You've analyzed them by the time that you've found that they don't exceed that. It's the same argument I had before.

MR. KING: No, you're picking them based on frequency. You're not sure where they're turning up in the --

DR. WALLIS: Oh, you're not? I thought they were -- well --

MR. KING: In the dose or consequence end. But on frequency --

DR. WALLIS: But if they were in your curves, then they were the same thing, okay.

MR. KING: Yes.

DR. RANSOM: Tom, the number of reactors, was there a target number of reactors in a population I guess that you would consider for setting these goals? It looked to me like the rear events, if you had a 1,000 reactors which at one time was an objective of this country and might still be in the term, it would occur anywhere from 10 to the minus 2 to 10 to the minus fourth per reactor year of operation which rare events seem to be moved up in the category in the frequent events.

MR. KING: Yes. We were looking at these on an individual reactor basis, not on a population of a 100 or a 1,000.

DR. RANSOM: But shouldn't you be looking at a population base?

MR. KING: Well, that gets back to the ACRS letter dealing with integrated risk, which is more than a modular reactor issue. it's a nationwide issue.

MR. ROSEN: And the Committee, we may provide you excellent guidance but splitting right down the middle.

CHAIRMAN KRESS: That's right.

MR. ROSEN: But you can't be wrong. You're always right.

MR. KING: Or always wrong.

MR. ROSEN: Or you're always wrong, that's right.

MR. KING: But the question is --

CHAIRMAN KRESS: I wanted to put names beside each -- but they wouldn't let me do that.

MR. KING: You know the safety goal policy has always been interpreted on a per reactor basis, and that's the way we've come up with these numbers. But there is the question of should we start looking at a per site basis, it may have -- whether it's 10 modules or a half dozen big plants, or should we start thinking nationwide, which is --

DR. RANSOM: Well, I thought we had agreed on that. But if you had 10 reactors there, why you've got to have safety goal that works one-tenth of a single reactor.

CHAIRMAN KRESS: We didn't agree.

DR. SHACK: But the integrated risk, we did for accident prevention.

CHAIRMAN KRESS: We all agreed on the LERF end of it, but on the CDF part we split. And some of us thought CDF was a specific design criteria for individual reactors. And you don't define a site CDF, which is a new concept. Some of us thought that way. Others thought differently. Others thought it was a good idea to have a site CDF. For the life of me I don't know why.

MR. KING: And you were even talking about a nationwide, you know, keeping the CDF nationwide at a certain value.

CHAIRMAN KRESS: We figured that you don't -- we build reactors so slowly, within the 40 to 60 year lifetime it didn't matter. I mean, you're going to get a slight increment in that, so we didn't have to worry about that too much.

MR. KING: Yes. But this is a policy issue that we're going to have to wrestle with over the next six months or so.

DR. RANSOM: Well, I assumed that like in one of the case latent cancers why it figures out to be about 25 people, you know, for 250 million population and that's kind of what those numbers mean, at least if I understand them correctly. But 250 million population you would see then roughly 25 deaths per year due to latent cancers caused by having them.

MR. KING: The 100 mrem you mean would cause that?

DR. RANSOM: The hundred?

MR. KING: The 100 mrem release from AOOs would cause that?

DR. RANSOM: Right, I think that's what it means.

MR. KING: You can work out the numbers, I'm not sure what they are. But you're getting then back to it's a societal question.

DR. RANSOM: You know, which is small because if you look at other accidents and what, that's a pretty small risk.

MR. ROSEN: And plants don't release 100 mrem.

MR. KING: No, no.

MR. ROSEN: That's the limit.

MR. KING: That's the limit.

DR. RANSOM: Right.

MR. KING: Yes.

CHAIRMAN KRESS: I have a little bit of a question about this. You've got these frequent events and infrequent events. And you kind of have an F-C curve as a guidance on it. But this F-C curve in my mind is an accumulative documentary distribution function, which in some way adds up all these things. And I hear you talking about defining specific events, but you've got the same acceptance criteria on specific events. And that seemed like a disconnect to me, and I'm not sure how to deal with that.

MR. KING: Well, we did it to try and so there wasn't a disconnect so we could pick a dose level that comes fright from the frequency conseq curve.

DR. WALLIS: You've got to figure out whether it's accumulative or not.

MR. KING: Yes. But there is a disconnect cumulative versus individual events.

CHAIRMAN KRESS: Yes, and that's the disconnect I have, yes. And I'm --

MR. KING: I'm not sure I agree with that.

CHAIRMAN KRESS: It just occurred to me. I didn't know how to deal with it.

MR. KING: I don't know how to deal with it either, but we tried to be consistent as we could and --

DR. WALLIS: I'm sure you'll work it out.

DR. RANSOM: Well is there an issue, too, that if you were talking about accumulative, for example, you can't have all of these accidents in one plant for example. It's only going to have one, presumably, if it has one at all.

CHAIRMAN KRESS: These are potential accidents we're talking about.

DR. RANSOM: Right, but only one potential accident. So it would make sense to take one plant and sum over all of these possible accidents.

CHAIRMAN KRESS: Sure it does.

DR. RANSOM: Huh?

CHAIRMAN KRESS: That's what we do.

DR. RANSOM: Because, you know, if it's a severe core damage accident, it's probably the end of that plant, whatever it has. So you may as well just take the worse one and that's the consequence.

MR. BLEY: But the chance that one of all of those happens is the sum of all of them.

DR. WALLIS: Right.

MR. BLEY: They're all very unlikely. At least one is.

DR. RANSOM: But summing over all of them seems like an impossible situation, one that would never occur --

DR. WALLIS: Well it's a sigma PI --

CHAIRMAN KRESS: That's the reason, though, it's the sum of all of them.

MR. BLEY: You wouldn't get all of them, that's the chance that you get one of them.

DR. SHACK: It is probability weighted.

DR. RANSOM: I may be misunderstanding the curve actually. You're saying that when you read a point on that curve, it's a probability that you would get on of those accidents?

MR. BLEY: It's one minus --

CHAIRMAN KRESS: It's not the probability. It's one minus the sum --

MR. BLEY: The cumulative of everything up to that point.

CHAIRMAN KRESS: -- the cumulative probability. And he's got it right. It's the complementary curve.

DR. WALLIS: Well, there are two

different curves you could draw at least. I mean, there's been a bit of confusion about which one's being drawn.

CHAIRMAN KRESS: Yes. That probably needs to be made clear in your document what the curve actually represents. And it is -- to my mind, it's a cumulative complementary curve --

DR. WALLIS: If it doesn't mean frequency, what do you mean by cumulative frequency--

CHAIRMAN KRESS: -- because that's what you calculated with the PRA. And you kind of needed to say a cumulative complementary curve is this and give the precise -- I think it's a precise mathematical definition of it just so people aren't confused about what that curve is.

Now, I understand you're kind of going away from not using it, but I think that's a mistake. I really think you ought to use that F-C curve.

MR. BLEY: It seems clear if we do, we have to work on it.

CHAIRMAN KRESS: You do need to work on it.

MR. KING: I think it ought to be an

option, but I think --

MS. DROUIN: We're not going to get rid of it. Because we really do feel exactly very strong. We have to leave that option in there.

CHAIRMAN KRESS: Yes. But worry about the surrogates won't cover the whole curve. You can't represent the whole curve with these surrogates. That bothers me.

DR. WALLIS: You can't have finite surrogates cover a whole curve.

CHAIRMAN KRESS: That's exactly my point. And so, you know, unless there's something about the surrogates that somehow force the design to meet the whole curve, and I can't see how that can be.

MR. BLEY: I think part of it is that point. You brought up that if you -- if we're using the same numbers now for a single event --

CHAIRMAN KRESS: Yes, that's part of it.

MR. BLEY: That's pretty conservative. If you can do that, there's no mathematical proof but there's a strong --

DR. WALLIS: Seems to disconnect somehow.

MR. BLEY: There is a disconnect.

CHAIRMAN KRESS: And it's a disconnect and it's not conservative in my mind because you're really supposed to be adding up --

DR. WALLIS: Anyway, you're going to sort all this out, I'm sure.

CHAIRMAN KRESS: Yes.

DR. SHACK: Well, except your experience tells you in the light water case that having the design basis accidents, when you finally get around to computing the frequency consequence curve, the surrogates did do the job, by in large.

CHAIRMAN KRESS: Yes. I think we were just lucky.

DR. WALLIS: No, they seemed to work.

CHAIRMAN KRESS: It seemed to work.

MR. ROSEN: Well, in a cumulative sense they -- but in a real sense they directed our attention to the large break LOCAs, which wasn't where the real --

DR. SHACK: I'm not saying it's -- it's just you made the statement that surrogates can't work. I'm saying that, you know there's some experiential evidence that in fact they worked better than one might think.

CHAIRMAN KRESS: Well, not surrogates.

What worked was the design basis accident concept. By designing the reactor to those, you ended up meeting probably being acceptable values for core damage frequency and large early release, although you got a real spectrum of those. Some of them I would say are acceptable.

DR. WALLIS: Except for the TMI design and what happened to it?

DR. SHACK: That's right. A small break.

CHAIRMAN KRESS: Anyway, continue, Tom.

DR. WALLIS: What concerned me a bit here was this loss of core cooling or fuel melting. What you really mean is something happening to the core, which could be chemical attack or something. It doesn't have to be heat that does it.

MR. KING: Yes. I think clearly fuel melting is not the right word.

DR. WALLIS: Integrity isn't the right word either, but something like that.

MR. KING: Something like that.

MR. BLEY: It's getting past some kind of barrier.

CHAIRMAN KRESS: Release of fission products.

DR. SHACK: You know, I always look at this DBA from a legal point of view, too. I mean if you don't use this, then you somehow have to defend the whole PRA in a legalistic licensing basis thing. Design basis accidents, you know, there's sort of a kabuki arrangement here. You know, you compute them a certain way and, you know, it is something everybody can agree on whether you did or did not meet the DBA.

CHAIRMAN KRESS: Yes, I agree. But I don't want those to be the exclusive regulations. I want that to be complimentary.

MR. KING: Well, this scheme is going to bring the PRA into the licensing --

CHAIRMAN KRESS: Yes, and I think that's a good idea.

MR. KING: It's going to be subject to litigation on here if it gets challenged. So this goes beyond what we do today.

CHAIRMAN KRESS: Yes, that's right.

MR. KING: But we do have the design basis accidents to say hey we're not in a risk based licensing arena here.

MR. ROSEN: Well, ten years ago that wouldn't have been acceptable because the industry wasn't ready to support that. But I think the industry is now.

MR. KING: And hopefully with the standards that are being written, we'll have some basis for saying this is a good PRA.

CHAIRMAN KRESS: And I think by doing it that way you have some real defense-in-depth then.

MR. KING: Yes. Yes.

CHAIRMAN KRESS: And I like it.

MR. KING: All right. Let me go onto 32. We also want to use a probabilistic safety classification scheme building upon the work that's been done 50.69.

MR. BLEY: Can I just sneak a little reminder in, Tom?

Back in the early '80s we in fact did have PRA show up in the hearings on Indian Point. And fairly lengthy hearings and they had some interesting results from that that did lead to conclusions.

DR. WALLIS: I think along the line of doing away with DBAs, I've never been clear why you really need to discuss safety classification criteria which we spend days and days wrangling about. You know, just look at the accidents and whatever is involved in the accident is important. But you don't have to classify them.

MR. ROSEN: That's what you're doing.

CHAIRMAN KRESS: That's what you're doing.

DR. WALLIS: But you don't have to have all this argument about whether they're in this part or that part --

MR. ROSEN: You just described the whole process.

DR. WALLIS: No, just --

MR. ROSEN: We look at the accidents, we figure out what the -- what's involved in them and we call those things --

DR. WALLIS: If they're in the analysis, which is important, then they're automatically classified.

CHAIRMAN KRESS: Sure.

DR. WALLIS: If you have a completed --

CHAIRMAN KRESS: You're saying you just mean two of those four boxes. The four boxes came about because of you got a lot of history.

DR. WALLIS: I know, it's too much history I'm wondering about.

CHAIRMAN KRESS: Yes. But for new plants

you might just have two boxes.

MS. DROUIN: Yes, just two box.

CHAIRMAN KRESS: It's important or it's not.

MR. KING: Where we draw the line, we've got to figure out. I mean, we had some strawman ideas that didn't work out, but we've got some work to do in this. But the idea is to use the PRA and have a two box scheme.

CHAIRMAN KRESS: Yes. I would not abandon the concept of using the PRA and the DBAs as determining my risk-important ones.

MR. KING: Yes.

MR. ROSEN: Well, the DBAs are a subset of the ones that -- defined a subset of the things that are risk-important. There are things outside the DBAs that turn out to risk important in severe accident space.

CHAIRMAN KRESS: Well, you know we had this whole debate. The reason we end up with the safety classification we had is because we looked at the DBAs and decided what was safety related and what wasn't. And it turns out that a lot of those were wrong when you do the PRA. So the final judgment was kind of based on the PRA. And now you're saying that's what you're going to do now?

MR. KING: That's the first bullet. We're not just looking at DBA analyses.

CHAIRMAN KRESS: Yes, I think that's --

DR. WALLIS: So the trouble with this with things like steam dryers where sort of it's legally determined that they're not important to safety and yet they fall apart and pieces go around or not go around, and it doesn't matter because they're not important to --

MR. ROSEN: That's because the analyses is not risk-informed and not complete.

DR. WALLIS: It's sort of ludicrous, isn't it? Artificially excluding certain things which turn out to be important.

MR. ROSEN: That's the way we used to do business, and what they're proposing is not to do it that way or don't don't do it that way.

MR. BLEY: And that's right.

MR. KING: And where you draw the line is we got to figure out.

DR. WALLIS: I'm not sure you're in the line.

MR. ROSEN: Well, wait a minute, Tom, one thing. Open items, why are those open?

MR. KING: Because we haven't figured out what the numerical criteria are for those.

MR. ROSEN: But in 50.69 space they're closed, and we know what to do with common cause failures and cumulative effect in 50.69.

MR. KING: Right. Right.

MR. ROSEN: Okay.So you could just follow that?

MR. KING: Yes, that's what we say here. We're going to build upon the work on the 50.69. We just haven't had the time.

MR. ROSEN: Oh, it's the matter of not getting the work done?

MR. KING: Right.

MR. ROSEN: Okay. But you have a direction?

MR. KING: We have a direction.

Slide 33, which is some thoughts on how we envision doing analyses under this scheme.

DR. WALLIS: Well, the confidence level has got to depend on the consequences. And since the DBAs are more consequential than the AOOs, I would think you would want a higher confidence level. 95 percent just pulled out of the air. The AOO is maybe you're perfectly happy with an 80 percent confidence, but why would you want --

CHAIRMAN KRESS: Well, there's several ways to look at that. One of them is that when they set the values for the QHOs, they said mean values. And the reason was, in my mind, had them classed 50/50. And the reason for saying that is if they wanted a 95 percent confidence level maybe they could have had a higher level on -- you know you could move this sort of up and down by moving the acceptance value down or talking about confidence level.

DR. WALLIS: Well, it must have in the consequence. I want an 80 percent chance of getting to the airport on time in the Metro, I want a 99.9 percent chance that the plane won't fall out of the sky. It depends on what you're doing. There's nothing magical about 95 percent confidence.

MR. KING: So you're saying for the things that are more likely to happen, you want a higher confidence?

DR. WALLIS: Or the things that are more important or whatever. The confidence has to be tied in some way to the likelihood on the consequence, it seems to me.

CHAIRMAN KRESS: If you're risk-adverse

and had to meet some criteria on a particular confidence level and the reason you asked for the confidence level because that saves your calculational tool is that you might use has different levels of uncertainty and depending on the design and natural plant implementation of it, then you would want a confidence on this mean, I think, even though the mean implies you have some -- that implies a confidence level. That implies a 50/50. But I think you might want to think about it being risk-adverse and actually having higher confidence level in the more consequential accidents, the higher level of consequence.

MR. BLEY: If there are deaths compared to.

CHAIRMAN KRESS: Yes. For several reasons. One, the uncertainties there are bigger and the consequence are worse, so you might want to have a higher confidence level.

DR. WALLIS: Isn't it tied in, I mean if you look at your curve here, you're allowing a five times 10 to the minus 7. Well, if that is where the 95 percent confidence, it might be that if you could get 100 percent confidence, you'd be happy with a three times -- no. A ten to the minus 6. I mean, they're tied together. If you're more confident, then you don't need to have a margin. So they're not independent, are they?

MR. KING: No, they're not independent.

DR. WALLIS: So I think they have to be tied together in some way, that's all I'm suggesting. You don't just pick 95 percent out of the air, but you relate it --

MR. KING: The air is what we use today for a lot of the DBAs.

DR. WALLIS: But it's just arbitrary. Someone's picked it out of the air.

CHAIRMAN KRESS: There is not a real technically defendable way to write an acceptable confidence level. It's a policy. It's what society or somebody is willing to accept in terms of what loss you're accepting.

DR. WALLIS: Society has never been asked, as far as I know.

CHAIRMAN KRESS: I know. Well, what we'll have to do is now say the Commission represents society, to some extent. And what you're asking is what loss am I willing to live with, at what confidence level.

DR. WALLIS: Or you'd have to --

CHAIRMAN KRESS: And there's no technical way to do that.

DR. WALLIS: I'd be happy to live with 50 percent confidence level, there was a much bigger margin. If you were going to pull it down to either the minus 7 or something, I would be happy with a much less confidence level.

MR. KING: If there was a big margin, then you'd have a higher confidence level.

DR. WALLIS: Right. So they're tied together. Not independent.

CHAIRMAN KRESS: Sure they're tied together.

DR. WALLIS: They're not independent.

DR. SHACK: But, again, your confidence level that you require is also dependent on the frequency with which you expect -- you know, if you really don't expect this thing to happen --

DR. WALLIS: Right.

DR. SHACK: You know, it's sort of okay that if it's got a reasonably small chance of working. But if it's really going to happen, it better work.

DR. WALLIS: But if it has very big consequences, then that changes it the other way.

Anyway, think about it. Think about it.

MR. KING: Our rule of thumb was for the risk analysis to use mean values, because that's what the safety --

DR. WALLIS: I guess you could fix the confidence level and that kind of fixes the margin, and that fixes where you put these lines then.

CHAIRMAN KRESS: The mean value fixes the confidence level, it's 50/50.

DR. WALLIS: Okay.

DR. SHACK: It may not be 50/50. It's probably almost never.

MR. KING: Seventy to 90.

MR. BLEY: You have almost no error bounds in 50/50.

MR. KING: Right.

MR. BLEY: But if you get factors of 10 or more, it moves up high.

DR. WALLIS: Well using maximum entropy, when you make a guess you're 50 percent confident, so it's all right.

MR. KING: The wider the uncertainty, the more the upper end the mean goes.

Anyway, the other thing I wanted to mention, the next to the last bullet, scenario specific equipment failures/human errors. You know, we're basically doing away with the single failure criteria.

MR. ROSEN: Thank goodness.

CHAIRMAN KRESS: Thank goodness.

MR. ROSEN: Put an end to -- history.

MR. KING: You go through your PRA -- that you're going to call AOOs and DBAs, whatever number of failure/human errors and so forth are in those sequences is what you put in your analysis and what you base your design on.

MR. ROSEN: Plus common mode I think.

MR. KING: Plus common mode. Yes.

Okay. Construction, just quickly. There's a couple of unique things I think, maybe not unique but new things we need to think about under construction objectives and how to deal with those. Factory fabrication, fabrication outside the United States where we don't have any regulatory jurisdiction.

DR. WALLIS: Rotterdam heads, is that what that is?

MR. ROSEN: You may not have regulatory jurisdiction, but plenty of clout. All you have to do is grab the licensee -- the applicant.

MR. KING: And basically there's this NUREG that's referenced, NUREG-1789 that just came out that basically has the principle in it that we need to put the control on the licensee and he takes care of this kind of stuff. He's the one that deals with the vendors, whether they're in the U.S. or outside the U.S.

DR. WALLIS: That's a dramatic number for a NUREG, 1789.

MR. KING: Anyway, so we want to carry that through into what we write in this document, be consistent with that.

CHAIRMAN KRESS: I think that's good.

MR. KING: And then I think the PRA can be useful in identifying areas for construction inspection.

MR. ROSEN: But you skipped the big bullet, which is the next to the last one.

DR. WALLIS: Fuel quality, that's very important.

DR. SHACK: Especially for an HTGR.

MR. ROSEN: Yes, technology-specific.

MR. KING: But again, I think the only practical way to do that is make sure the licensee has adequate controls on the fabrication plan. If it's in the U.S., maybe we can do some audits or something. But I don't envision the NRC taking responsibility for the fuel quality. The licensee has to.

CHAIRMAN KRESS: Well, they may want to think about how to assess the fuel quality and once it gets put in the plant.

MR. KING: Yes.

CHAIRMAN KRESS: And I think there they may have some responsibility.

MR. KING: I agree. I agree with you. And today when we go to fuel fabrication plants, we're not so much worried about the fuel quality, we're more worried are the guys that work there being protected properly.

MR. ROSEN: Criticality control and that sort of thing.

MR. KING: Yes.

CHAIRMAN KRESS: But then when they stick the fuel in the plants, you got controls on how much activity gets released and stuff like that.

MR. KING: Right.

CHAIRMAN KRESS: Which is a measure of fuel quality there. And I think you still have to have that in your --

MR. KING: I agree with you. The sampling in the QA program needs to be agreed upon.

MR. ROSEN: I'm of two minds about that point, let me give you most perspectives.

One is that if the fuel's made in this country and, therefore, you can go into the plants and be another layer of inspection and eyes and quality control, and given the central importance of fuel quality, the performance of those machines, I would think the NRC has an important role. That's one side.

On the other side if you do things that way, you may drive fuel manufacturing overseas where you have no role and can't have a role. And so --

MR. KING: But our role then would be dealing with the licensee to make sure what we think needs to be done is done.

MR. ROSEN: Right. But you could do that in the U.S., too, and never go into a fuel fabrication facility. So that's why I'm of two minds of it.

If the fuel is going to be made here, and I hope it will be ultimately, I think the vendors would be willing and able and in fact pleased to have NRC inspectors in addition to their clients inspectors so that they could show just how great their fuel making processes are. And so proud of them that they're willing to have anybody come look at it.

DR. RANSOM: At the same time, though, the framework probably should not be constrained to that assumption, I wouldn't think.

MR. KING: No. But I --

DR. RANSOM: It's most likely going to be a global market.

MR. KING: Yes, that's true. But I'm just saying that it's a wonderful opportunity in a lot of ways to go right at the central issue of performance about that particular technology, because the fuel performance is crucial to everything.

MR. BLEY: I'm a little surprised we went so fast past the non-U.S. fabrication of other things than fuel. I know we talked about it some, some of the railroads have been finding they're bringing parts, electronics, other things in from overseas. They have certified vendors, they have contracts with third parties in other countries; all the paperwork's right. But they're getting components that don't work.

MR. ROSEN: Well, I didn't know.

MR. BLEY: More failures in the field.

MR. ROSEN: But I know that there are a lot of components going into current light water reactors, steam generators and that sort of thing that are being fabricated overseas. And there licensee quality control measures in these overseas factories is essential. Because the translation of our requirements and our quality standards to these overseas shops is not simple. And it may involve language barriers. But more importantly than language, it involves standards. How good do you really want it to be? How clean do you want the shop to be? How precise do you want it to be? And maybe some of our standards are, in fact, better than European in some areas and not as good in others.

So, I think you know it's the traditional role of the customer. It seems tome, it has to be very much reenforced to go in and demand. Given the nature of what's being done here, the importance of it, that should be reenforced at every stop.

DR. WALLIS: Don't assume it's worse if it's fabricated overseas.

MR. ROSEN: No, no. It could be better.

DR. WALLIS: It seems to me the inspection is very important.

MR. ROSEN: It could be better, but different.

DR. WALLIS: It might well be better.

MR. ROSEN: It might be better, but it might be different and that is --

DR. WALLIS: Then it is the inspection that is important.

MR. ROSEN: And that alone creates a difficulty.

MR. KING: Yes. And there is always you're using non-U.S. codes and standards which if they propose to do that, we're going to have to review them and either accept them or reject them. But we need to put that provision in as well as to allow that to happen.

DR. WALLIS: It may well be that the utility finds that it can buy fuel for half the price somewhere else.

MR. KING: Yes.

DR. WALLIS: And it's going to do it.

MR. ROSEN: I think we have enough experience from looking at non-U.S. fabrication of safety related components to know that it's not trivial, not a trivial issue.

MR. KING: Okay. Slide 35, quickly operational things. Normal operation, we don't see any difference in requirements than we have today for plants.

Accident management program, we would expect to have some requirement that requires an accident management program to address what we call beyond design basis accidents. We would expect that they have an EP program, although the extent of that would be dependent upon the design characteristics, and that's discussed under defense-in-depth.

And then protection of the operating staff. Back in the beginning of this presentation we said that we're developing requirements to protect the public, the environment and the worker. And the way we envision protecting the worker is part of it would be continuing what we do today in terms of protection of the control operating staff building upon GDC-19. The other part would be in developing the accident management program requiring that whatever actions have to be taken outside the control room, the worker has sufficient shielding, training, whatever, protective gear whatever he needs to take care of that within the dose requirements under 10 CFR 20.1205, which is for dealing -- I forget the official name, but it's heroic action kinds of things. There are provisions in Part 20 that allow these special exposures for emergency type conditions and there's dose limits associated with those as well.

MR. ROSEN: On a voluntary basis.

MR. KING: Yes.

CHAIRMAN KRESS: how are you going to deal with the question of what is an adequate number of operators?

MR. KING: That's an issue that has to be dealt with, it's more or less going to be plant specific.

MR. ROSEN: I think that's the bullet normal operation training, procedures, tech specs and in your accident management, you're going to also need training procedures and tech specs.

MR. KING: Yes.

MR. ROSEN: And it's under the accident management where your procedures gets to the questions as raised.

DR. WALLIS: I'm wondering if the control room will be like the traditional control room. If you have ten modules on site, there are different ways to manage that.

MR. ROSEN: It won't be anything like the traditional controls. It'll be computer monitor.

CHAIRMAN KRESS: Yes. It'll be ten different --

MR. ROSEN: I don't think it'll be ten, it'll be one probably. Ten buttons to press, unit one, module two --

MR. KING: Yes, the whole issue of staffing is an open one that has to be dealt with.

MR. ROSEN: Well, where does it get dealt with? Here, or some other process?

CHAIRMAN KRESS: I think when you certify that, we're going to deal with it somewhere.

MR. ROSEN: No, I'm going back to this model when Mary started the discussion.

MR. KING: It's going to show up somewhere in this model.

MR. ROSEN: In the technology-specific framework?

CHAIRMAN KRESS: Yes, it needs --

MS. DROUIN: Well, there is going to have to be some high level criteria that's technology-neutral and then guidance on how you would apply that on a technology specific basis.

MR. ROSEN: Well, it seems to me that's perfect for a technology-neutral criteria. I mean, a criteria that says the operating staff has to be able to carry out the procedural actions in accident management.

MS. DROUIN: Exactly.

MR. ROSEN: With adequate reliability and time margin.

MS. DROUIN: Exactly.

CHAIRMAN KRESS: That's the top level.

DR. WALLIS: It's performance-based.

CHAIRMAN KRESS: And how to translate that into a real number of operators is going to be tough, but that's the top level.

MS. DROUIN: And where that translation shows up would be the technology-specific.

CHAIRMAN KRESS: Yes. In the PRA. In the PRA.

MS. DROUIN: And then many operations would be in the Reg Guide.

CHAIRMAN KRESS: Yes. I think that's a good approach.

MR. ROSEN: And you have to say that that's the operating staff on site at the minimum staffing, with the minimum staffing. I mean, normally they'll have lots of other people that can come help them, but there will be times when that's not true.

DR. WALLIS: Well, typically our approach has been to be performance based and to define the functions, not to say how they're going to be performed. So maybe you don't need to say number of operations. You need to have a demonstration that these functions can be performed by whatever. Maybe it's no operators.

CHAIRMAN KRESS: That may be the best way.

MS. DROUIN: Did any of you see on Fox last week "Meltdown," they only had two.

CHAIRMAN KRESS: I missed that.

MR. ROSEN: I didn't know about it, but I would have missed it if I did.

MS. DROUIN: In the whole plant.

MR. KING: We haven't dealt with the issue of staffing yet. It has to be dealt with.

All right. Now we can move on.

MS. DROUIN: Yes.

DR. WALLIS: Now there's one word for it. You had too many words about defense-in-depth and the reason was you weren't quite sure what it was?

MR. LEHNER: We try to cover all bases.

CHAIRMAN KRESS: Do you know what it is? Does anybody know what it is?

MS. DROUIN: Okay. John?

MR. LEHNER: All right. So we want to briefly talk about the approach we took to treatment of uncertainties, which of course is use of defense-in-depth. We mention the types of uncertainties we feel we have to deal with, and then talk about the defense-in-depth principles, the model that we envision and how it would be applied.

So in the approach, the defense-in-depth has been a fundamental part of the NRC's safety philosophy. And basically we're saying that the reason that we have defense-in-depth is because of uncertainty. In other words, if there was no uncertainty you wouldn't need the defense-in-depth. So that's the premise.

CHAIRMAN KRESS: It's not that you have uncertainty.

DR. WALLIS: That's not necessarily so.

CHAIRMAN KRESS: It's just that you have an inability to really quantify that uncertainty. If you could really quantify them, you could deal with the uncertainties by using confidence levels.

MR. LEHNER: Yes. I guess it depends upon your definition of uncertainty also.

MS. DROUIN: I disagree because you can't quantify what you don't know.

CHAIRMAN KRESS: That's what I said, that's the reason you have the defense-in-depth, you can't quantify. If you could, you could deal with it all with confidence levels.

DR. WALLIS: This is true, though. You have multiple barriers because it's good design practice, and the PRA says it works. Because even if you have no uncertainties, it's still a good thing to do.

DR. SHACK: You see most of the --

MS. DROUIN: It's a good thing to do because you're uncertainty.

DR. WALLIS: Even in the deterministic world you want defense-in-depth

MR. LEHNER: Oh, sure.

MS. DROUIN: Because of uncertainties.

DR. WALLIS: No.

DR. SHACK: Because if you design objective. I mean --

CHAIRMAN KRESS: That's right.

DR. SHACK: I would think that most of what we credit to defense-in-depth doesn't treat uncertainties. It's what you have to do in order to make design objectives.

DR. WALLIS: That's right. Absolutely.

MR. LEHNER: I think it sort of depends on how you define uncertainty. I mean, we're taking a very broad definition of uncertainty here.

DR. WALLIS: Well, there's an additional amount of defense-in-depth you need because of uncertainty. But it's not the fundamental reason you have defense-in-depth.

DR. SHACK: Well, if I take my example, you know, a containment is -- I don't look at it as defense-in-depth on a current model reactor, by in large, because I need the containment to met my design objectives. It is, in fact, defense-in-depth for an advanced LWR because at least, if I believe the PRA, I could meet my design objectives within a containment. And so when I put the containment on an AP1000, it's a true defense-in-depth measure, aside from my physical --

MR. LEHNER: Yes, in that sense I think that's certainly true that there are elements that are in the design that also serve as defense-in-depth systems. That's certainly true. But --

DR. SHACK: Yes. The defense-in-depth somehow gives the impression, at least, that you know I don't really need this when in fact I really do.

MR. ROSEN: Well, I guess my position on this is that you don't need defense-in-depth if you have a total knowledge of uncertainty and of the confidence bounds. And they're narrow enough. But I said there's a huge "if" in there. That if is that you cannot get there from here because of the irreducible problem of model incompleteness uncertainty.

DR. WALLIS: But you still have a sequence of values so that if one fails, the other holds and if that fails, another holds.

MR. ROSEN: Yes.

DR. SHACK: Unless I could --

MR. LEHNER: But if you knew perfectly how your reactor worked, why would the barrier fail?

DR. WALLIS: Then you have it because in order to meet your objectives. You have 10 percent chance of this failing, 10 percent chance of that failing.

MR. LEHNER: Well that's uncertainly.

DR. WALLIS: An overall chance --

MS. DROUIN: But that's uncertainty.

MR. LEHNER: That's uncertainty.

DR. WALLIS: That's not uncertainty.

MR. ROSEN: No, that's stochastic. And I think -- well, what you do is you sum those up. And if you get to 10 to the minus 7 or 8 --

DR. SHACK: If I know the probability exactly, is it uncertain? No.

MR. LEHNER: The point right here we're trying to make is the definition of uncertainty.

MR. BLEY: You don't need a requirement on defense-in-depth without uncertainty. It'll be there by design to meet your objectives, but you don't need a requirement for it unless there's some uncertainty. That's what we're trying to say, and maybe we didn't say that clearly or maybe there's not a way to say it clearly.

DR. WALLIS: Okay. By uncertainty you mean because the things are probabilistic or because there's uncertainty about the probabilities?

MR. MUBAYI: Both. Both.

MR. BLEY: Both. Yes, both.

MR. MUBAYI: And the next slide --

MR. LEHNER: Yes, actually when we talk

about the different kinds of uncertainties.

Well, we just discuss here where this has been mentioned in past NRC documents. And what we want to do here is we want to build on that past practice or try to come up with an implementation that's more consistent and more quantitative and traceable in implementation.

So if we go to the next slide, we've listed here the types of uncertainties that we have to deal with. And the first one, the random uncertainty is that one that you just mentioned that's inherent in the fact that we have probability distributions. And then we have the epistemic or state of knowledge uncertainties. We've divided these up into parameter uncertainty, model uncertainty and out of model uncertainty we've separated completeness, analytical, special importance.

DR. WALLIS: That's a difficult one. That's a difficult one.

MR. LEHNER: Yes.

MR. ROSEN: I think with completeness uncertainty is much more important when you're talking about new reactors.

MR. LEHNER: Yes. Yes.

MR. ROSEN: And thousands of years of experience that you would assume that after you have thousands and thousands of year of experience, it would show up. It may not be a good assumption, but at least you have some chance of it.

CHAIRMAN KRESS: Reactor years.

MR. ROSEN: Reactor years, yes.

But in a case where you have zero experience --

MR. LEHNER: Yes, we agree completely. That's an essential issue with new reactors.

CHAIRMAN KRESS: But you know these thousand of reactor years of experience with light water reactors doesn't all get thrown out the windows when you're talking about new plants. I mean, you've learned a lot about reactors in general.

MR. LEHNER: Sure.

CHAIRMAN KRESS: So you know you still can use that information.

MR. ROSEN: Oh, yes. There's lots of things that are in common. They both have neutrons. They all have neutrons.

DR. SHACK: And from other industry.

CHAIRMAN KRESS: As well as you'll have

similar shutdown mechanisms.

DR. WALLIS: Doesn't this also apply to risk contributors that you have thought of but you got no idea how to analyze them.

MR. LEHNER: Yes. Yes.

DR. WALLIS: I guess that's why the second one.

MR. LEHNER: Yes. And even it can apply to contributors that you may even know how to analyze, but it's not economical or not worth doing.

DR. WALLIS: Or it's so difficult to do?

MR. LEHNER: So difficult to do, yes.

DR. WALLIS: Like the sump blockage issue.

MR. ROSEN: Oh, I thought you said you were making progress, Graham.

MR. LEHNER: Okay. The next slide talks about the defense-in-depth principles, basic qualitative principles. And the first one, for lack of a better terminology, it again mentions accident prevention and mitigation recognizing that what's prevention in some sequence would be considered mitigation in another sequence and so forth. But nevertheless, that the design incorporates a balance between preventive measures and mitigative measures.

DR. SHACK: Yes, I've always had a problem with that. You know, if I have two plants with the same risk to the public; this one says the one that has a sort of a 10 times greater chance of core damage that wipes out my huge investment is really a better, more optimized design.

MR. LEHNER: Well, a balance we're not talking about, you know 50/50 here.

MR. BLEY: I think the utility might have other -- beyond risk, public risk.

DR. SHACK: But even from the NRC's point of view, that just doesn't strike me as a conclusion I really want to come to. And I'm not sure what I mean by this.

MR. ROSEN: Well, what you mean is an ounce of prevention, sort of the pound of cure.

MR. LEHNER: Right. You don't want to put all your eggs in one basket.

DR. SHACK: Well, but the balance from my mind is so heavily -- you know, if I really think I'm preventing the accident, I really want to prevent the accident.

DR. WALLIS: That makes more sense, yes.

CHAIRMAN KRESS: That's what you mean the balance.

DR. SHACK: Well, when we write down these frameworks, you know, we have 10 to the minus 4 and CDF --

CHAIRMAN KRESS: And 10 to the minus 1 on containment. That's a balance, isn't it?

DR. SHACK: Yes, but then does that mean that PWR which more or less satisfied that is a better design than my BWR which probably has a much lower CDF but a much higher containment failure? I'd probably rather not have the accident.

DR. WALLIS: This is true. Almost everything in daily life or of a big consequence, you'd much rather prevent than try to mitigate after the thing.

MR. LEHNER: That's true. But I just want to point out that's true because you can make that statement because of the experience you've had with the kind of reactors.

DR. SHACK: Yes, that's true. I'm placing my confidence in the fact that CDF really is low.

MR. LEHNER: Yes.

DR. SHACK: And that's always a problem.

MR. LEHNER: And so when we're talking about --

DR. SHACK: When you say "balance" I don't think you really mean balance.

MR. LEHNER: Not equal balance, certainly.

MS. DROUIN: You don't need equal balance. It doesn't mean 50/50.

MR. LEHNER: No, not equal balance.

DR. SHACK: Well, I'm not even sure you mean equal balance. You mean sort of a structuralist thing here.

MR. LEHNER: Yes.

DR. SHACK: That until I'm extremely confident --

MR. LEHNER: Yes.

DR. SHACK: -- in my accident prevention, I want mitigation. But if I really am confident about that prevention, I'm willing to kind of slide on the mitigation stuff.

DR. WALLIS: Or if you have a really robust mitigation --

MR. LEHNER: Not completely. Not completely.

MR. BLEY: We all have to be comfortable.

MS. DROUIN: And when you get further

into the slides you will see that it captures both of those.

CHAIRMAN KRESS: But let's examine that just a little bit. I like Bill's thinking here, believe it or not. Let's look at th gas-cooled reactor concept. Now, let's assume that they can actually achieve the quality of this fuel design that they claim they can, and that you can demonstrate someway that it actually has that quality.

Now, you have a probability of or a frequency of core melt -- the frequency of a release of fission products at all was extremely low. And you're highly confident in that. You're highly confident in that because you can't figure anyway to get the fission products out even though you look at all the types of accidents you might be able to get. How much mitigation do you really need, do you need in containment? I mean, I think you have to face up to this. And I think the uncertainty has to enter in here. The uncertainty on your ability to determine this prevention has to have something to do with how much mitigation you need with the balance. Somehow you need to relate --

DR. WALLIS: The probability that you

might be wrong is what you're looking for?

DR. SHACK: Yes. The irreducible uncertainty of incompleteness.

MR. KING: You got a bad batch of fuel from the fabricator.

DR. SHACK: Well, physical protection may trump all of these considerations.

CHAIRMAN KRESS: Yes, that very well could be.

MR. LEHNER: That's true.

CHAIRMAN KRESS: That very well. But you know, physical protection could be -- I don't care what you do to this reactor, even if it doesn't have a containment on it, you might not be able to release fission products.

MS. DROUIN: But you will in the slides we're going to get exactly to this point, because this is a fundamental in our model.

MR. LEHNER: Yes, I think it's better illustrated in a later slide here.

DR. WALLIS: Okay. We'll let you get on. But if your slide avoids wishy-washy terms like balance, which we can't determine, there's no way --

MS. DROUIN: No, but on a -- you know that's what the viewgraph.

DR. WALLIS: I know what's on the viewgraph.

MS. DROUIN: You know the framework document hopefully explains what we mean by balance.

DR. SHACK: Well, I still have trouble with, you know, every time I see that in every framework document and then I see the exact illustration, it still says to me I really rather have 10 to the minus 4 and 10 to the minus 1. And I say no, I'd rather have 10 to the minus 5.

MS. DROUIN: Anyway.

MR. LEHNER: All right. Yes, Bob, it could say something like you can't ignore one.

DR. SHACK: Now that -- really these core principles are structuralist principles.

MR. LEHNER: Yes.

DR. WALLIS: It's like balance between prevention and cure of disease, isn't it? I mean, certain disease are much better prevented then cured and other ones like common colds, you might as well just let happen.

MR. LEHNER: True.

DR. WALLIS: I don't think you can say there's some magic balance you have to achieve.

MR. KING: It's not there's a magic

balance, but it's do you totally want to let go of mitigation?

MR. BLEY: I think what we've meant by balance is that block five on that earlier picture where you're looking at the results of the PRA, what you've got from your design accidents, what you've got from your protective strategies and how those are working together and that's the kind of balance. That integration of all of those with consideration of the uncertainty. So it's weighing those things against each other rather than a 50/50 or a ten to one, or anything --

CHAIRMAN KRESS: Well, let me ask you a practical question given this framework. If I come in with an HTGR and I say I can meet all the F-C goals that you have without a containment at all, not even a confinement. And I'm coming in with that as my design is certified. Now, how are you going to deal with that issue? You're going to make me put a containment on it? And what kind of containment is it going to be?

MR. KING: Core spray.

MS. DROUIN: Okay. Before we answer that, I think John is going to get to that specific kind of question when we get to the next two slides.

CHAIRMAN KRESS: Okay. I'll let you go ahead.

MS. DROUIN: So I really urge let him get through the next slides.

CHAIRMAN KRESS: Okay.

MS. DROUIN: Because I think it will answer it.

DR. WALLIS: There is another extreme, which is a reactor which is lousy but you put a humongous containment on it, anything happens there's no consequence.

MR. ROSEN: Or as long as you put it on the --

MS. DROUIN: I think these issues are going to be answered in the next two slides.

CHAIRMAN KRESS: I don't think we would allow that.

MR. ROSEN: I hope not.

MR. LEHNER: All right. So the other principles are, you know, a second one simply is redundancy and diversity, basically. And the third one says that you want to have -- whatever reliability goals and calculations you do, that you would account for the uncertainties and the equipment and the human performance.

And then finally --

DR. WALLIS: This "single element" gives you troubles because are you talking into parts of a system or single systems within other systems and so on? I know what you mean, but --

MR. ROSEN: I don't know what you mean when you "uncertainties in SSCs." Do you mean reliability of SSCs, unavailability of SSCs? What's this uncertainty in SSCs? I mean, the only real uncertainty --

MR. LEHNER: Yes. It's the fact that the reliability goals you set up take account of the uncertainty. And the calculations that you do take account of the uncertainty.

MR. ROSEN: Wording could improve.

MR. KING: It could be more than reliability. It could be performance.

MR. ROSEN: Right. Performance, reliability.

MR. LEHNER: Yes.

MR. ROSEN: And availability.

MR. KING: Right.

MR. LEHNER: Right. Okay.

Now lastly, we're just saying that the way you site plants should ensure public health and safety is basically what we're saying here. You know, you shouldn't site them in Central Park.

MR. KING: We're not talking about urban siting here.

CHAIRMAN KRESS: That's a good idea.

MR. KING: General population incentive and that kind of stuff.

MR. LEHNER: Okay. The next slide then talks about the defense-in-depth model which is a combination of structuralist and rationalist?

CHAIRMAN KRESS: Where did you get that idea?

MR. LEHNER: We heavily referenced your papers in our framework. I was going to say, the term I'm sure is familiar to everybody here.

DR. WALLIS: The people who defined defense-in-depth in for reactors didn't know anything about structuralism or rationalism. They did it anyway.

MR. BLEY: They did. They just didn't use those words.

MR. LEHNER: Yes. So what the -- and again, this is similar to some of the ideas that were espoused in papers by some of the members here.

The structuralist, the model is

structuralist at a high level. And we think that our protective strategies constitute the defense-in-depth at the structuralist level, at that high level. In other words, those -- well, the four strategies plus the physical protection. If you take those four strategies sort of in a time sequence order, that is limit initiating events, have protective systems for mitigating accident, have barrier integrity and finally accident management; that those four elements, those four strategies I should say taken together represent a high level structuralist defense-in-depth model.

And this primarily is useful for addressing the completeness uncertainties and some of the model uncertainty as well, but primarily for completeness uncertainty.

Within each one of those protective strategies we want to apply a rationalist model that quantitatively looks at reliability or hits the performance goals that are set up for each one of those protective strategies and assures in a quantitative manner that you've met -- if you meet those performance goals and you can meet them, this is very important, including the uncertainty.

DR. WALLIS: Well, I thought this was

interesting and then I thought well I'd love to see an example, where you take the very useful model and you say I got fuel and I got a containment. How do I trade off more reliability in the fuel against more reliability in the containment? How do I make a decision based on your structure here? And if you can't show me how I would make a decision, I don't know how to use that.

MR. LEHNER: Well, we think we want to include examples here.

DR. WALLIS: Because, obviously, there are different combinations of, you know.

MR. LEHNER: Yes.

MR. BROWN: Getting a fuel which is very, very robust and getting a very robust containment.

MR. LEHNER: Well, notice that when we talk about barrier integrity, we're not necessarily ---

DR. WALLIS: So how would you make decision based on this? It sounds very interesting in terms of words, but you could show some example of how you actually apply it to reach a better conclusion than if you hadn't applied it, then that would really be a very helpful --

CHAIRMAN KRESS: Well, let me give you my example. If I had used the strategies that I mentioned; limit fission product release, limit exposure to workers, limit release to the environment and that, if I had done that I would have had individual F-C curves acceptance values. These have nothing to do with the design, they're acceptance values. On each one of these limits. Okay.

Now, if a design now comes in and calculates this first F-C, limit on the release of fuel accepted in terms of an F-C there, and that F-C happens -- I'm expressing it in terms of a confidence level also.

DR. WALLIS: That meets the one that you have for the plant.

CHAIRMAN KRESS: Then you have got it.

DR. WALLIS: And you don't need a containment?

CHAIRMAN KRESS: That's correct. But it has to be done at a particular confidence level and you have to be able to -- there are elements in there, you have to also meet the design basis defense, too.

DR. WALLIS: I think if you believed

that you'd say AP1000 didn't need any containment.

CHAIRMAN KRESS: Possibly. Possibly. But, no, the confidence level there -- we haven't done the confidence level on that one yet.

MR. ROSEN: Yes, but your analysis, how do you deal with completeness uncertainty? Can you still --

CHAIRMAN KRESS: You have to also meet the design basis accidents, which are -- you take every accident type and you put stringent requirements on it just like we do now. You have to meet both of them. And that was supposed to take care of the completeness problems.

MR. ROSEN: It doesn't really unless you -- it's a matter of faith. You think you've got everything that could happen covered, but you --

CHAIRMAN KRESS: Well, when you're talking about completeness, everything is a matter of fact in terms of how you do it.

DR. SHACK: But even your confidence level. I mean, I can always go through a formal confidence level calculation. But confidence level that I need before I remove the containment however, I suspect -- you know, needs far more than a formal -- you know, I somehow almost need a physical reason that it's impossible to have this happen.

MR. ROSEN: But I think your earlier comment, Bill, is correct. And it's be trumped by the physical protection. I mean, this is an interesting discussion, but that's really what it is.

DR. WALLIS: It may be trumped by public perception.

MR. ROSEN: It may be trumped by public perception? But in any event, trumped.

MR. LEHNER: Anyway, this slide is sort of is the essence of the concept that it shows a structuralist and an rationalist aspects. And basically the structuralist part is that we're saying you can't completely ignore any one of those protective strategies. That there has to be some allocation given to each one of those protective strategies.

CHAIRMAN KRESS: Now when you look at the yellow box underneath the protective systems.

MR. LEHNER: Yes.

CHAIRMAN KRESS: And you have associated with it the level of confidence on acceptance criteria, would you give an example of what an acceptance criteria might be there?

MR. LEHNER: for the protective systems?

CHAIRMAN KRESS: Yes.

MR. LEHNER: I guess in this case it would be a reliability level, an acceptability reliability level of the system.

CHAIRMAN KRESS: Of a shutdown of the scram.

MR. ROSEN: Reflood if the reactor requires reflood or --

CHAIRMAN KRESS: How do you arrive at a reliability acceptance value on reliability? What are you going to use to decide on what's an acceptable reliability?

MR. KING: You're working backwards from your 10 to the minus to the fifth, 10 minus sixth overall plant numbers seem to meet those, I need certain reliability of my systems that contribute to --

MR. ROSEN: You look at the split fractions and then dominate sequences.

DR. WALLIS: You have more reliability in the next box than in the --

MR. LEHNER: Yes. The designer can allocate the reliability among these boxes up to a certain --

MS. DROUIN: The acceptance --

MR. ROSEN: You can't put zero there. Yes.

DR. WALLIS: The designer has a great time, it's the regulator who has difficulty deciding whether it's acceptable or not.

MS. DROUIN: I mean overall acceptance criteria are your risk guidelines that we're established. And the only time you can ignore those, and you don't have to worry about meeting them, is when you're in an extremely rare category.

So when you're making a decision and you're saying, okay, you know I've got my protective strategy here and you look at the accident scenario of concern, you now if you're in the frequent you can balance. I mean, you can put a lot of it, maybe you make your reliability on your protective systems 95 percent. And you do less under your barrier integrity or you switch off. But across all of them you still have to meet the overall risk guidelines goals. And that's what I'm saying where you can come in and balance. You can choose but you can't have zero reliability in any of them unless you're below the 10 to the minus 7.

DR. SHACK: Now as a practical matter we

almost always end up partitioning these things. That is if you pick a rare event, you know, a PTS event or maybe a large break LOCA when we get to it, you know we're going to have some sort of frequency for that and you're going to have to decide how you're going to partition up the sort of degree. Do you have any guidance on that?

CHAIRMAN KRESS: Yes, you've got a lot of rare events --

DR. SHACK: You got a lot of rare events and how much am I going to attribute to PTS, how much am I going to attribute to large break LOCA, how much --

MR. ROSEN: Well, the practical matter is the designer is the user, the customer who is paying for it or some --

DR. SHACK: No, no. The regulator is going to accept something --

MR. ROSEN: I know. But the guy who is going to -- who is paying for it will have a designer who will told to make sure that this thing, that prevention is very strong for all the reasons we mentioned before. So you're going to have a strong prevention because that's what the customer desires.

DR. SHACK: My frequency of a large break LOCA is down 10 to the minus 5, 10 to the minus 6. It's pretty small, but I'm still going to have to deal with it.

DR. WALLIS: You going to relax --

DR. SHACK: But, you know, I have a 10 to the minus 6 probability of that. I maybe have a 10 to the minus 6 probability of a PTS or something. You know, I've got a bunch of rare events. How do I -- am I going to count my rare events or I'll assume that there's not that many of them and I'll pick some number like two?

DR. WALLIS: You've got to be independent of consequences. I mean if your consequence of the large break LOCA is 10 the seventh times as big as the consequence of the frequent events, maybe it's more important even though its frequency is so small.

MR. BLEY: Exactly.

DR. WALLIS: So I don't know the frequency is the only criterion.

DR. SHACK: -- big consequences.

DR. WALLIS: Is frequency the only criterion here? Certainly consequence has to figure into the --

MR. ROSEN: Well, it's risk, which is the product of frequency and consequence.

CHAIRMAN KRESS: Yes. I think what they have there, they were just defining what the terms are. That's not the acceptance criteria.

MR. LEHNER: Yes, that's not the acceptance criteria.

MS. DROUIN: No.

CHAIRMAN KRESS: I mean, that's just defining what those are.

MR. LEHNER: It's the risk guidelines at the end that are the acceptance criteria.

CHAIRMAN KRESS: Yes. Which has the consequence in them.

DR. WALLIS: Does it?

CHAIRMAN KRESS: Yes. Yes. Making that acceptance criteria --

MR. ROSEN: Frequency times --

DR. WALLIS: No, it's just frequency.

CHAIRMAN KRESS: No.

DR. WALLIS: There is no -- there are only frequency and CDF is only frequency. Anyway --

MR. LEHNER: Well, yes, that's true for the very last, the extremely rare what we're saying the frequency is.

MS. DROUIN: I mean, for the extremely rare, yes, you're just looking at frequency.

CHAIRMAN KRESS: That's because --

DR. WALLIS: Apparently you are.

CHAIRMAN KRESS: But I think Bill has a legitimate question. If you had 100 extremely rare events, that may not be the acceptable value for each one of them.

DR. SHACK: But you're not going to have a 100 extremely rare events.

CHAIRMAN KRESS: No. So you're pretty sure you're not going to have very many.

DR. SHACK: But am I going to have two, three, four.

CHAIRMAN KRESS: Maybe this is a level that already --

DR. WALLIS: Well, again, this looks good. I would think you ought to work through some sort of example looking at rather extreme cases and say how would it play out in this picture. What decisions would it lead you to make.

DR. SHACK: Yes. Especially when you apply it to problems like PTS and large break LOCA that you're going to have to deal with.

DR. WALLIS: Right.

MS. DROUIN: Oh, yes.

MR. BLEY: Tom, I think we were leaving out as both the total and any individual, weren't we, when we talked through this.

CHAIRMAN KRESS: Okay.That could be in the total.

MR. BLEY: On the rare, on the extremely rare? We used that both as a total and an individual?

DR. WALLIS: Does this patter help us decide what to do about 50.46 today>

DR. SHACK: Well, I see PTS and large break LOCA sitting in the rear --

MS. DROUIN: They are using a lot of this stuff that we are establishing this framework to be consistent with 50.46. They are looking very closely at what we're doing there.

DR. WALLIS: It is helping?

MS. DROUIN: That --

DR. WALLIS: I would love to have a framework for resolving that one.

MS. DROUIN: I think the answer would be yes.

DR. WALLIS: Well, that's it. I mean if you can show that it's work on a difficult problem, that would be wonderful.

CHAIRMAN KRESS: When you're talking about barrier integrity, I mean let's talk about barriers, although I don't like that. Do you mean conditional probability of failure, is that what you mean by the integrity?

MR. BLEY: This one is a little -- you know, these are integrated, protective systems and barriers you can't think of independently --

DR. WALLIS: That's right.

MR. BLEY: -- because the protective systems are protecting the barriers. The success criteria used for them are ones aimed at giving certain levels of protection. So it's not quite as separatable as ---

CHAIRMAN KRESS: That is that when you get --

MR. LEHNER: And even using them as a preventing events that could threaten the barriers.

MR. BLEY: Yes, that's right. So they're not --

DR. WALLIS: So a barrier is acquiring --

CHAIRMAN KRESS: Yes, but it still seems to me like it goes down to a conditional probability of failure.

MR. BLEY: Yes.

DR. WALLIS: Effective system is a cooling system for --

MR. BLEY: That's right.

MR. KING: I think you're right. You're down in the yellow box under barrier integrity, that's right.

MR. LEHNER: Yes, that yellow box.

MR. KING: And when you're in a green box of barrier integrity, it's whatever the Commission decides on the containment and whatever we want to say about cladding integrity and pressure boundary integrity.

MR. LEHNER: Oh, that's right. Yes. That's right. The yellow box below it is a failure probability.

I guess the other thing here, even though I hesitate to mention it, is that I mean we say none of them can be zero. I mean I guess the question is how low can you go in any one of them, which we haven't really defined.

MR. ROSEN: you said "balance."

MR. LEHNER: Yes.

MR. BLEY: But we haven't completely

defined it.

MR. ROSEN: Does balance include zero?

MR. LEHNER: No, it doesn't include zero. But we don't know how close to zero you can get.

DR. SHACK: Epsilon.

MR. MUBAYI: No, it's an asymptotic --

MR. LEHNER: All right. The next figure then describes the application or how we see that this would be implemented where initial design would be --

DR. WALLIS: Well, I'm sorry. I'm going to say something about this. It all traditional engineering design you have an optimization criteria and you can trade off these boxes against the other.

MR. LEHNER: Yes.

DR. WALLIS: That's the rational way of doing all engineering. And I don't see a mechanism for trading off here. It's all sort of arbitrary decision. You have you can't be less than 10 percent of that and so and so. You really need a measure. It's going back almost to risk or something as a measure.

MR. KING: Yes, you can trade off.

MR. LEHNER: You can trade of.

DR. WALLIS: Well, I don't know, unless you have a measure or something I don't know you make a rational trade.

MR. KING: The overall measures out on the right.

DR. WALLIS: I suspect the decision they developed to have a huge robust containment or have much better feel is really an economic one.

MR. LEHNER: Yes.

MR. KING: Oh, sure.

DR. WALLIS: And you haven't said anything about economics.

MR. LEHNER: Yes, but this --

MR. ROSEN: It's the designer who makes all those decisions.

MR. LEHNER: Yes, exactly. This is --

MR. MUBAYI: This is not the regulator.

MR. LEHNER: The regulator wouldn't make the economic decisions, right?

MR. ROSEN: No, the designer. The designer makes the economic decisions.

DR. WALLIS: The balance will be achieved by economics.

MR. ROSEN: And then he presents that to the regulator and he has to balance that's dictated by the design and economic design and as well as safety design. And if the regulator accepts that, fine. If not, then it gets maybe a little distorted, it's not quite economic. It's not ultimately economic.

MR. BLEY: Right. But there's this other side of balancing against uncertainty, and we haven't really worked out how you do that. But there's been a lot of various projects in the last ten years where people have put a lot of effort into quantitatively trying to structure the areas of uncertainty. And every time you do that you seem to learn a lot of about the things you might be missing in the process. So somehow that's part of this process. And where there are reasons to suspect the completeness and the model uncertainties are substantial, that's a place where you'd be less willing to go to low reliability valuables for strategies across the top. And we haven't implemented that yet in anyway. We've just talked about it.

MR. LEHNER: So this illustrates to have a flow chart way the way we think of the implementation of this. That you would have an initial design that incorporates the protective strategies. There would be a risk assessment performed on that design. And then one would examine for each protective strategy, first of all the -- whether it meets the rationalist parts of defense-in-depth in terms of reliability goals including the uncertainties. And if not, then you would have to iterate on that until you've met those rationalist goals. That's the loop from box 4 and 5. And you would reexamine your revised design, box 3.

And then when you've satisfied the rationalist aspects, you would do --

MR. ROSEN: Now hold on just a step. What happens at that stage usually is that the design parameters for a given system are determined by the worst condition that that system has to perform under.

For example, a pump that performs in different sequences may only have to pump a 100 gpm in one sequence and 1,000 in another. So the pump's going to be sized to do a 1,000. It's always going to be sized to achieve its most severe function. So there's a step of, yes, you have to know them all and basically come down and look for battery. DC power, you have to look at the ampere that'll draw for each. So the batteries are sized for the worst condition. So there's another optimization step in there. I don't know if you need to show that. But that's really what goes inside that block. Is you do what you say there and then you do an optimization or a limiting from an engineering point of view for each of them.

And your systems come out very robust that way.

MR. LEHNER: Yes.

MR. ROSEN: Because the systems, you know, in the individual systems in the plant, in hardware end up being able to handle the worst condition for the worst sequence and usually are not stressed for most of them.

MR. LEHNER: Okay. I see your point.

I was going to say that -- first I was going to say that might in the initial design, but I see what you're saying. This would actually be in the safety analysis as you would incorporate this?

MR. ROSEN: Yes. Once you've identified the dominant sequences.

MR. LEHNER: Right.

MR. ROSEN: Then you'd go down on a system-by-system basis trying to identify what is the controlling condition for the design of this system.

MR. LEHNER: Right.

MR. ROSEN: And maybe that's too detailed.

DR. WALLIS: But you don't necessarily have to analyze. You could have this design so that a gremlin goes in there and tries to screw things up by making a pump not work or making -- it's just like a risk of treatment worse, but you do it just automatic. Once you got this thing, you go in there and you let this gremlin go around and do certain things and see if it's a robust system.

MR. ROSEN: I don't know how I'd do it.

DR. WALLIS: Well, it would have to say, look, you've all this stuff --

MR. ROSEN: Well, you have the success--

DR. WALLIS: Suppose you were wrong about this ability of this pump to switch on and just don't let it switch it off.

MR. ROSEN: Yes. Well, you do that. That's in fact what you do.

DR. WALLIS: Okay. You do that already.

MR. ROSEN: Sure, it's in the PRA.

DR. WALLIS: But you don't have to actually follow all these things yourself. You just have a gremlin go in and do it.

MR. ROSEN: The PRA has yes or no.

DR. WALLIS: Yes.

MR. ROSEN: And the yes and no is determined by the success criteria. So it's the success criteria that ultimately tell you how to size the system.

MR. LEHNER: You take the most stringent success criteria --

DR. WALLIS: But you don't have to switch it on. You can get defense-in-depth by letting it happen sort of random.

CHAIRMAN KRESS: But tell me, where in this chart does your design basis accidents fit it, assuming you got such --

MR. LEHNER: Well, we don't explicitly show them. The part that the design basis accidents add to defense-in-depth are not explicitly shown here, that's true.

CHAIRMAN KRESS: It seems like it ought to be.

MR. LEHNER: We'll include that now.

CHAIRMAN KRESS: Yes. There ought to be some way to show it in here.

MR. KING: When you do your design basis

analysis, you may find I need to do something different in the design.

CHAIRMAN KRESS: Yes.

MR. KING: And that's not show on here.

MR. LEHNER: That's right. I should actually --

CHAIRMAN KRESS: I think you need a box or something.

MR. BLEY: Yes. Somewhere where we talked about the strategies it would be a parallel--

MR. LEHNER: Right.

MR. ROSEN: So now we got a risk of assessment based on risk, which identifies the systems that are needed and their most critical function, their most -- whatever did I say -- their most stressful function. And then you go down to the next one where you do a structuralist check?

MR. LEHNER: Right.

MR. ROSEN: Now tell me about that.

MR. LEHNER: Well, this goes back to those defense-in-depth principles. In other words that you're not relying on a single system or any single operator action or over reliance on operation actions for instance to prevent certain accidents.

MR. ROSEN: Well, to get a concrete

example of that, we have all these sequences now at this stage, you've done all that work. So now you can look at the sequences and tell the computer to tell me all the operator actions. Print out all the operators actions on all the sequences and tell me what the most important one is. What's the most risk significant operator action. And if there's one that sticks way out from the others as being the reason that this sequence comes out low, is because the operators are --

DR. WALLIS: Well, just go through all the actions and screw up one of them. You can do it easily with a computer. You got thousands of --

MR. ROSEN: Yes. Well, I say, that's effectively what you're doing is you're putting out the most important operator action. And if it's way out of line with the others in terms of the reliability that's assumed or it's risk consequences. If you do it right, it's great. If you do it wrong it's awful. Whether or not you not you go to core damage or not depends upon human performance under this circumstance. That's where I think you're saying you'd do something different?

MR. LEHNER: You would do something different, yes.

MR. ROSEN: You'd apply a structuralist approach at that point? You'd say well maybe we're not going to stop right there, we're going to ask for some additional compensatory measures or systems or something?

MR. LEHNER: That's right. So you wouldn't have to rely on just that action or maybe the series of actions that you'd need.

MR. ROSEN: So it springs up a matter of a careful review of the PRA looking for these vulnerabilities where individual systems or operator actions look like they're very, very important. They stick out from the --

DR. WALLIS: I'm glad you added system, not just operator actions.

MR. ROSEN: Systems or components or operator actions, yes.

MR. LEHNER: Chokepoints basically that could --

DR. WALLIS: That's right.

MR. ROSEN: Well, I think that's right. And I think in a good design what happens you don't have -- the risk of all these different sequences, no one dominant sequence completely swamps all the others out.

DR. WALLIS: Because there are ways of getting around that mistake.

MR. ROSEN: Yes. Because what you've done if you have those things, one or more, you take some actions and then run the calculation over and it pulls them in.

MR. LEHNER: Yes.

MR. ROSEN: So then now you got faced with well, okay, now I want to reduce the risks more but I don't know where to put my effort because these things are all about the same now. Well, the answer then is stop. And the design you have is telling that you are where you're going to be in terms of risk.

MR. LEHNER: I think the way you said is what we should -- it is the way we should express here

MR. ROSEN: But I just want to be sure I understand what you --

MR. LEHNER: Yes. That's exactly right.

MR. KING: But there may be other structuralist thing, too. One of the things we're thinking of, for example, is reactor shutdowns. Do we to specify, you know, redundant diverse ways to shutdown the reactor, just make that a structuralist requirement. And then --

CHAIRMAN KRESS: I would.

MR. ROSEN: But wait a minute now, Tom. What about -- I think I know the answer to my question, but what if the shutdown system you have is extremely reliable, five nines. Do you want an alternative diverse shutdown system?

I think the answer, and here this case, is probably yes because of that incompleteness, again.

MR. LEHNER: Yes.

CHAIRMAN KRESS: Because you can't demonstrate that kind of reliability. There's no way you can know it's going to be that reliable.

MR. ROSEN: That's right, and because we don't have any experience.

CHAIRMAN KRESS: That's right.

MR. ROSEN: Maybe in the second or third generation of these things after you have that several thousand years of reactor experience --

DR. WALLIS: After you've shut them down many times.

MR. ROSEN: Which is never.

MS. DROUIN: But I disagree. I think what you put in the requirement is that you have to meet the principle. The principle, you know, comes back and says -- I don't think you come in and say, you know, you have to have a shutdown this system and this. But you have to meet the principle that says -- I'm trying to get back to the viewgraph. You know, that your key safety functions are not dependent on a single elements.

Now, you move it up to the designer to come and demonstrate how he does that. And one way he may come back and demonstrate it is that, you know, he has --

CHAIRMAN KRESS: He may have a strong negative temperature coefficient.

MS. DROUIN: He might have that. He might have an alternate shutdown. You know, don't pigeonhole the designer on how to do it. Because we're more interested that, you know, he meets that principle.

CHAIRMAN KRESS: But that's what we kind of meant redundant.

MR. ROSEN: Redundant and diverse.

CHAIRMAN KRESS: Yes. It didn't have to be --

MS. DROUIN: I mean, we say the words, you know, you should be redundant and diverse. But don't say that in order to meet redundancy and diverse you have to have a shutdown system. You have to have an alternate --

CHAIRMAN KRESS: Yes, it could be --

MS. DROUIN: To me that's going the next step.

CHAIRMAN KRESS: What you have to do is meet the requirement of turning off the power. Yes.

MR. KING: So if one doesn't work, the other one hopefully will.

CHAIRMAN KRESS: Right. That's right.

Now in step 8 down there, what's the meaning of that middle sentence. I'm not sure I understand it.

MR. LEHNER: Actually, one of the thoughts there was, for instance, on support systems that you might have support systems which could effect more than one of the protective strategies. And if you degraded that system --

MR. ROSEN: Won't the PRA if done properly where the support system is modeled correctly will show.

MR. LEHNER: It should, yes. I guess this is meant to say that even if you meet the PRA risk guidelines you should make sure that there isn't that kind of degradation. Again, the completeness uncertainty.

MR. ROSEN: I'm not sure I would know what to do in step 8, given that I have confidence that the PRA if modeled correctly, and by this time you've got to have confidence in your model, is going to turn up those support system dependencies. It's going to say this support system is very important because look at all the sequences it effects. For example, look how important the common modes failure in the support system is.

MR. LEHNER: That's true.

MR. ROSEN: I don't think that's a flaw here. I think, you know, it forces you to ask the question but I think there might be a blank faces. If it's a good design, there will be a blank of faces at that point. Everyone will say --

MR. LEHNER: Why do I need this?

MR. ROSEN: We're okay. I think, here look at this PRA, look at all how it handles it. Nothing comes out of that final check if the design is okay. If something comes out of it, you've got a real show stopper probably.

MR. LEHNER: Well, that's why it goes all the way back up to the initial design box there.

MR. ROSEN: Yes.

MR. LEHNER: Yes, if the answer is no you basically start over.

MR. ROSEN: Yes.

DR. WALLIS: Suppose I have a modern reactor and I say I'm going to treat the design like an underground nuclear test. I'm going to put it in a cavity, you know, 200 feet down there. Do you care about anything else?

MR. KING: If it melts down --

DR. WALLIS: Who cares? Who cares?

MR. MUBAYI: Well, we actually do, we have it for the high level risk repository --

MR. LEHNER: I was going to say --

MR. MUBAYI: You're going to be down there for the next 10,000 years. This is just a --

DR. WALLIS: Sometimes the extreme case helps to clarify some of these things. Then you don't need a balance between anything.

MR. MUBAYI: No.

DR. WALLIS: One thing just overwhelms everything?

MR. MUBAYI: Right.

DR. WALLIS: Is that an acceptable design?

CHAIRMAN KRESS: Yes, because your uncertainties are minuscule there.

MR. MUBAYI: Right.

CHAIRMAN KRESS: You know that you're not going to reduce anything under those circumstances. So on your final end point acceptance--

DR. WALLIS: You're backing off from that.

CHAIRMAN KRESS: Your final end point acceptance criteria, I mean you know it with a very small uncertainty. Therefore, it's probably acceptable. That was my concept, if you a had such a thing.

MR. KING: Well, I can't imagine we'd go that far.

DR. WALLIS: Well, I'm just saying --

CHAIRMAN KRESS: No. But in the extremes that's -- that why you have to tie this balance to uncertainties.

DR. WALLIS: So to the other extreme we have a fuel to which nothing can happen.

MR. KING: HGTR.

DR. WALLIS: Right.

CHAIRMAN KRESS: Now, I don't think

you're as certain about that one as you are --

DR. SHACK: Especially if you were Oak Ridge fabricated.

CHAIRMAN KRESS: Yes. Then you're pretty uncertain.

MR. LEHNER: Well, I guess to complete this slide, the final box that we talked about including provisions for performance monitoring and feedback line. Especially for new plants that you can quickly learn from them.

MR. ROSEN: That's a regulatory requirement anyway.

CHAIRMAN KRESS: Yes.

MR. ROSEN: Corrective action program.

MR. LEHNER: And then the last slide of this -- or the last two slides, I guess, of this chapter review how this defense-in-depth model would address the various uncertainties.

MS. DROUIN: Don't you think, John, we've covered these? I'm just trying to get these.

CHAIRMAN KRESS: Yes, it's okay with me.

MS. DROUIN: Can we slip these next two slides?

DR. WALLIS: Now we're getting to the important part. Chapter 6.

MS. DROUIN: Tom, it's five after 5:00. How long do we have to --

CHAIRMAN KRESS: How long do you -- do you have somewhere to go?

DR. WALLIS: How long will it take? Can you do it?

CHAIRMAN KRESS: I think we're getting close to the end. Why don't we just go ahead and go through them.

MS. DROUIN: Okay. Tom?

MR. KING: Yes. Chapter 6 is where we take all of this stuff in chapters 2 through 5 and try and decide, okay, what's the scope of the requirements that we need to write and then how do we test that to make sure it's complete, it's practical and so forth.

What we've done is take the protective strategies and we've defined a set of questions under each protective strategy that are the kinds of things that you would need to answer to make sure that protective strategy is implemented properly. And we're in the process of trying to develop answers to those questions. And in developing answers to those questions, hopefully what we're doing is identifying the topics that we're going to have to have requirements for.

The framework is not actually going to have the requirements in it. The framework's just going to be sort of a table of contents of what the requirements would should have. And then the next step would be to go write the requirements based upon that table of contents and based upon the high level guidance in the earlier chapters.

DR. WALLIS: By "requirements," you mean essentially regulations?

MR. KING: Right. In effect, they would be hopefully very close to what the regulations look like, maybe some technical basis to go along with it.

You know, my own person view is they'd probably look something like the general design criteria in terms of the scope and depth of the wording. They may be totally different in terms of the technical content, but that's my concept of what these things would look like.

How many there would be, I'm not sure.

MR. ROSEN: I mean, you're suggesting that we'd have a parallel set of general design criteria? Would they fit in the same place in the regulatory hierarchy?

MR. KING: These would be regulations. You know, this thing's going to replace, be an alternate for Part 50.

MR. ROSEN: Okay.

MR. KING: In terms of how much you write into regulations, my thought is you'd might probably go as far down as the GDCs go in terms of describing functions, you know system structures and components, whatever we end up writing in the requirements. But, no, they would not be an appendix or something like the GDCs are now

DR. SHACK: They would be lower level than the GDCs.

MR. KING: No, I think they'd be a higher level.

MS. DROUIN: A higher level.

DR. SHACK: They will be the regulations.

MR. KING: Or, yes, they would be the regulations.

DR. SHACK: And then the rest of it's implementing documents.

MR. KING: So like now, the regulations I mean we have a few technical regulations. We have, you know. 50.54 hydrogen control and 46 on ECCS, but a lot of the stuff in GDCs and Appendix A.

My view is the regulations, there wouldn't be an Appendix A with GDCs. We'd take all the technical stuff and put it in some logical order in the regulations themselves. So the regulations would talk down shutdown, decay heat removal, you know risk criteria, whatever it is that ends up going in there.

MS. DROUIN: Well, they would be in the order of the protective strategies.

MR. KING: Yes, in order of the protective strategies.

MS. DROUIN: And a higher level than GDCs or the appendixes, the Part 50?

MR. KING: Yes, I think they would be.

MR. ROSEN: They might be some other part, I mean new part?

MR. KING: No, no.

MR. ROSEN: No? In Part 50.

MR. KING: Well, this is sort of an alternative to Part 50. It's sort of another -- somebody could take this and use it in place of Part 50. You either pick Part 50 or you pick this new set of regulations to use if you're a designer or an applicant.

MR. ROSEN: Okay. So something parallel to Part 50?

MR. KING: Something parallel to Part 50 that has the technical and it also the administrative, so it's sort of a stand alone document, you're not going back and forth.

MR. ROSEN: Okay. That's the answer to my question. Where does it fit?

MR. KING: And it would fit with Part 52 in terms of the certification process. Part 52 could say, hey, you could Part 50 or you can use this new thing. You know, pick one.

DR. SHACK: Well, I mean the new guy though is not going to have much choice, right, the HTGR walking in is going to basically have to use this one?

MR. KING: I think from a practical standpoint he'd want to use this one. He could take Part 50 and go through all the exemptions and everything that you'd have to do. But --

MR. ROSEN: Part 50 allows exemptions, that's for sure.

CHAIRMAN KRESS: This would be a better--

MR. KING: This would be better, but you

know everything would be subject to litigation if he takes that route. Whereas, this route at least you'd have regulations you wouldn't be subject to litigation. If you take the old Part 50 route, you're --

CHAIRMAN KRESS: I'd know which way I'd choose.

MR. KING: -- exemptions and you have to add stuff in. And all of that stuff you add in is subject to litigation.

MR. ROSEN: And exemptions you have to show why are the exemptions appropriate. What's new in and prove it. I think it's a 50.12 test or something like that.

MR. KING: Yes. And then given this set of requirements that's sort of written at the GDC level or a little higher level, then we would have a technology-specific reg guide that would actually add any additional guidance for an HTGR or an LMR or whatever to implement it.

DR. WALLIS: I'm looking at the list of things here. It seems to me that fuel disposal is important. I mean it's no good having a pebble-bed reactor, which is absolutely perfect in normal operation, and then you take these pebbles and so five years, because of time effects, they crumble into a powder. And you've got to look at the whole cycle somehow, not just what happens in operation.

MR. KING: Onsite fuel storage is part of the scope of this.

DR. WALLIS: Part of the scope. I think that's important, right.

MR. KING: Yucca Mountain or wherever this would go ultimately is not part of the scope of this.

DR. WALLIS: Okay.

MR. ROSEN: That's analogous to what we have now, Part 50.

MR. KING: Yes.

DR. WALLIS: And this might be the weakness that some of the fuels that are wonderful in operation, but where you try to store them for a long period of time, they're not so good.

MS. DROUIN: Well, and the other goal, you know, by doing this in the structure that we have in terms of having the regulations technology-neutral and getting into the technology-specific at the regulatory guide level, and if you look at the current Part 50, particularly looking at 50.46 and 50.44 which, you know, get quite prescriptive; that level of prescriptiveness would show up in the regulatory guide that we're writing. The regulatory guides that we're saying that would be technology-specific would not be comparable to the set of regulatory guides that support Part 50 right now.

So the technology-neutral, the language in that would be, as Tom says, a high level. And the whole aim of this is that as we learn and have to change, we would be changing at the regulatory guide level and have, hopefully, fewer changes at the regulation level. It's a lot easier to change a regulatory guide than it is to change a regulation. And that's one of the efficiencies we're trying to, you know, build into this structure.

MR. KING: Okay. And then quickly on slide 48, the last bullet there, there's going to have to be some administrative requirements as part of this to make it a stand alone new part that applicants could use dealing with things like PRA scope and quality, analysis methods.

DR. WALLIS: Excuse me. If you have really good regulations, maybe you wouldn't need so many reg guide if the regulations focused on things that really mattered clearly, it would be obvious what you had to do.

MS. DROUIN: I would say that when the regulations were written, they thought they did that. And as we go through time, we learn things. And I don't see that being any different.

DR. WALLIS: Well, it seems the criterion for good regulations is you don't need too many reg guides.

MR. KING: Ideally. Ideally that's true.

MR. ROSEN: But in this case we're doing technology-neutral. You definitely are going to have technology-specific --

DR. WALLIS: You have to write the specific reg guides, but you might not need reg guides for the technology-neutral part.

MS. DROUIN: Yes, we weren't intending on writing specific reg guides.

DR. WALLIS: I thought you said reg guides for the neutral part as well?

MS. DROUIN: No, regulatory guides for the technology-specific.

DR. WALLIS: Then I got mixed up. Okay. Sorry.

MS. DROUIN: No. Not intent to writing reg guides for the technology-neutral.

DR. WALLIS: Good. Thank you.

MR. ROSEN: Even the Constitution has a bunch of amendments.

DR. WALLIS: It doesn't need anymore, though.

MR. ROSEN: What about Arnold?

MR. KING: One of the things that we're going to have to figure out how to do as part of this whole process is the PRA that's used for the application is going to have to be a living PRA over the life of the plant. And as part of that living PRA process, we may point to some changes that have to be made. You know, maybe a new design basis accident or, you know, some change in a tech spec or something. We've got to figure out a way to have a change process that isn't too over burdensome. We don't want every change to have to come to NRC, particularly if a design is certified and where right now the rules say for a certified design if you want to make a change, you've got to go through another rulemaking. We haven't figured out how to do that, but we need some sort of 50.59 process that takes care of most of these things unless there's some real major --

MR. ROSEN: See, licensees are already making living PRAs, using living PRAs. They're updating every several refueling cycles.

MR. KING: Yes. But now if the PRA is part of the licensing basis of the plant, how do we handle changes in the PRA that need to effect changes in the plant.

MS. DROUIN: So it's not just -- sorry.

MR. KING: I mean my thought is hopefully most of that can be done like a 50.59 type thing.

MR. ROSEN: Yes. Parametric changes that change CDF because you're updating your experience.

MR. KING: Right. Exactly.

MR. ROSEN: And that kind of thing ought to be, you know, just reported. But things if you make model change that changes the CDF more than, say, X percent, then that's the more reporting. It would require approval.

MR. KING: Some threshold where it has to come in here and get some approval.

MR. ROSEN: And I think if you look at 50.69 or you look at the exemption from South Texas, you might see some criteria for that. Because that subject was addressed.

MR. KING: Okay.

And the last one is slide 49. I

mentioned earlier, check for completeness and practicality. We haven't done any of this yet. These are some thoughts as to what we would do.

DR. WALLIS: Practicality is the thing that concerns me.

MR. KING: Yes.

DR. WALLIS: How do you do it and does it work.

DR. SHACK: those academics are always concerned about practicality.

MR. KING: Yes. I mean, the one we do have lined up, in fact we have our first get together with them next month, the VHTR via DOE. DOE is paying Idaho to take their design and take our draft framework and see how the two fit together.

CHAIRMAN KRESS: Good idea.

MR. KING: We'll see what comes out of that.

These other things are some ideas. We haven't done anything yet in those areas.

DR. WALLIS: Well, that's why I just saying idea. I see problem areas of the past are prevented, that's a good test, too.

MR. KING: Yes. Okay. That takes us to

the end.

Mary?

MS. DROUIN: Okay. Some things that is going to be in this framework document that you haven't seen that we're working on, you have seen the Appendix A which is in your draft document that you have.

We're also working on a glossary going through and trying to identify key terms and coming up with definitions so that we do have a common understanding as people read the document.

Tom talked about DOE is supporting us on this effort. They've hired Idaho. And Idaho is doing several things. They'll be producing technical reports to DOE, and we hope to glean a lot of insights from those technical reports and bring into this framework.

One of the things that they are producing is this technical report that is trying to look at all these as well as we know today, you know, the different concepts that are out there and getting into a discussion of the different safety characteristics. And the purpose of this document, this appendix is so that as we try and make this technology neutral, we're trying to make it technology-neutral. And we still, as best we can, you know all of our experience is still LWR. And so we want to look at this and make sure that there's not some subtle in there that has excluded something to the best that we can.

MR. ROSEN: I was puzzled by B, Appendix B, the characteristics of Gen IV reactors. Why in the world would you have that in there? I mean, Gen IV reactors or class of reactors that DOE spent a lot of money on, but they're only one set of reactors.

MS. DROUIN: That's misleading. It's not just Gen IV.

MR. ROSEN: What is it?

MS. DROUIN: It's all -- it's all the different ones that are out there.

MR. ROSEN: Is this under glossary and appendixes -- well the appendixes. The glossary is one thing. The appendixes, what is going to be in B?

MS. DROUIN: B is going to try and look at all the different concepts that are out there besides the LWRs.

MR. ROSEN: Look at and do what with?

MS. DROUIN: And identify what are their unique safety characteristics associated with each of them.

MR. ROSEN: And see, that goes in the regulations?

MS. DROUIN: No. No, no. This is just going into the appendix?

MR. ROSEN: of?

MS. DROUIN: Of our framework. It's just going to be a description.

DR. SHACK: It's some of the things you might have to start thinking about in the future.

MS. DROUIN: Well, and some things that we hope that as we write our regulations, we're not writing something that has precluded or somehow inconsistent --

MR. LEHNER: But, Mary, you may want to point out the framework will be a NUREG and these are appendixes to the NUREG, right?

MS. DROUIN: Yes.

MR. LEHNER: So it's not appendix to a regulation or anything like that.

MS. DROUIN: No, no, no. This is appendix to --

MR. ROSEN: A lot of effort was put in on that GEN IV, I was involved in it. And they picked six systems. But it seems to me strange to be going into those in this document.

CHAIRMAN KRESS: Well, she says it's not going to be just those six. She's going to talk about other --

MR. KING: Yes. And we have written sections already, just general characteristics of ALWRs, HTGRs and LMRS. From the standpoint of LMRs you got to sodium-water reactions and sodium fires and things that you want to make sure that the framework pickups or the new requirements pick up.

MR. ROSEN: So you're just pulling out all this stuff out of the DOE documents? I mean, there are shelves of these documents over a period.

MS. DROUIN: Yes.

MR. KING: Yes.

MR. ROSEN: Pulling that stuff up into here so that a reader can pick this one book up and look at the stuff you've put together and then look at the appendixes and see whether he thinks it covers the known set.

Now, the next reactor, the advanced reactor that's built in the Generation V time frame may be entirely different. It may not be one of those at all, it may be this evolutionary machine.

MS. DROUIN: That's right.

MR. BLEY: But having the set to think about as you're doing this work is a place to start.

MR. ROSEN: Puzzling.

MS. DROUIN: The next one is --

DR. SHACK: No guarantee of completeness, as usual.

MS. DROUIN: No, that's right.

MR. KING: That's right.

MS. DROUIN: That's right.

MR. BLEY: More a guarantee of incompleteness.

MS. DROUIN: You now ASME has come out a standard on your level 1 part in LEFT. ANS has issued their standards, there are standards coming out on power and low power shutdown. Now all of those standards in terms of your PRA have been written from an LWR perspective. That doesn't mean that there's not a lot there that's not applicable, but we are going through those standards and looking at them. And we hope to get into quite a bit of discussion on what the PRA quality we're talking about when we look at new reactors.

I mean, one of the things that to me jumps up right away is there's nothing on passive systems right now. When you look at the ASME standard, it's totally silent on that. That's an issue for reactors.

So what PRA quality, maybe what new methods need to be developed, what tools. So we're right now starting on that appendix.

Tom talk about international codes and standards. We're going to be addressing that one.

We are going to go through Part 50 and look at it and give our assessment of where we think it's technology-neutral, what parts of the technology are specific, and hopefully maybe where there are some holes in it and summarize that in Appendix E.

CHAIRMAN KRESS: The gas-cooled people kind of did that one time. You might start from there.

MS. DROUIN: Hopefully none of this we're starting from scratch. I mean our intent on all of this is try and go from whatever has been done.

CHAIRMAN KRESS: They had a whole list of things about Part 50 they thought was -- and it specifically for gas-cooled reactors, it wasn't applicable, it was application.

MS. DROUIN: Yes. And then Appendix F

is, you know, one of our desired characteristics is that this would be performance based. And here's where we would document the guidance for how we would formulate a performance based requirement.

Going back, you know there was SECY-03-0046 which got into the seven policy issues for non-light water reactors. You know, the Commission came back, approved five of them, two of them on integrated risk and containment give us more information. And then they disapproved that they want codes and standards. But on the others, when you it got into like defense-in-depth, safety classification and all of those we said we were going to resolve and address through the framework. So that will be coming up.

But also as we have been doing this work besides those policy issues, we have identified some other policy issues. And between now and the rest of the year we might identify some more. So those we're going to be working on. And here's just --

DR. WALLIS: I thought you already assumed on the one.

MS. DROUIN: Integrated risk. That one was already in there.

DR. WALLIS: Didn't you already assume

on the one?

MR. KING: Yes, we assumed that we got to get the Commission to say --

DR. WALLIS: Oh, they're going to change their safety policy? Maybe.

MR. KING: This is writing the regulation, not changing the safety goal policy, but writing the regulations to achieve that goal of safety. Right now that's not the case.

DR. WALLIS: Well, I think you should hold them to it. If they say it's a goal, then it should be.

MR. KING: But they've also said it's their ideal goal is how safe is safe enough. This is a different approach.

CHAIRMAN KRESS: I think you'd be shot down completely unless they approve that. I mean that's such a --

DR. WALLIS: Otherwise you don't have a basis, do you?

CHAIRMAN KRESS: But you're right, it's not -- it's a policy --

MR. KING: It's clearly a policy, probably the biggest one.

MS. DROUIN: So here just some of them,

try and come up with a --

DR. WALLIS: Tell them they can't use the safety goal policy, they've got to have frequency-consequence curves, see what happens.

MR. ROSEN: Well, this is a question, do you really mean that safety goal policy? Is that what you're really asking the Commission? Isn't that sort of a --

CHAIRMAN KRESS: No. The safety goal policy doesn't help us at all because it's -- it doesn't say anything about requirements and regulations.

DR. WALLIS: So it's an empty statement?

CHAIRMAN KRESS: No. This is our goal for the level of safety on the average for the whole plants and then I'm going try to craft our regulations so that that's somehow met. I mean, it's a requirement to anybody.

MR. KING: But the Commission did say in their advanced reactor policy statement that they expect future plants --

MS. DROUIN: It would be separate.

MR. KING: -- to meet the safety goals.

CHAIRMAN KRESS: Yes, and I think this regulation makes it --

MR. ROSEN: So you're just saying okay, Mr. Commissioners, the rubber meets the road right here.

MR. KING: Right. You expect it, will you require it.

MS. DROUIN: And this is -- because this is fundamental to our framework.

DR. SHACK: Should be shall.

MR. KING: That's what it is.

MS. DROUIN: You know, we've discussed the treatment of integrated risk, the security issues. It is in the scope, but it's kind of on a back burner right now. We've talked about the license by test approach and selective implementation. You know, that's still an issue that keeps --

MR. ROSEN: No, I don't know what that means there, selective implementation in this sense. I know what it is in other context, but what does it mean here?

MR. KING: The same thing.

MS. DROUIN: The same thing.

MR. KING: You want to pick and choose --

DR. WALLIS: I would say how will

security issues be included. Well, they obviously can't be excluded. Maybe you don't do it, but how will the Commission --

MS. DROUIN: I mean, our idea that this is alternative to the entire Part 50. That's one option.

An option is can they take parts of ours, not the whole thing in its entirety and take part -- well, I would like to think no.

MR. KING: Like pick their DDAs using the PRA and then go into current Part 50 and apply there. I mean, you know, those kinds of things.

MS. DROUIN: And separate them.

MR. ROSEN: In this license by test, do you want to make a few statements about that? What do you mean there?

MR. KING: This is something in the DOE concept that they purposed --

MR. ROSEN: Just build one and --

MR. KING: Particularly for the modular plans, build a module, run it through a bunch of tests to prove how safe it is --

DR. WALLIS: So how many design basis accidents do you have to go through with this thing?

MR. KING: Well, that's one of the

questions. But instead of doing a whole bunch of R&D and separate effects tests, and scale model integral tests, you build a module and actually run it through somebody's test and use that as a basis for getting a license.

CHAIRMAN KRESS: You kind of validate your calculational costs --

MR. KING: It froze. But it has a lot of--

CHAIRMAN KRESS: Yes, it has some merit to it.

MR. KING: A lot of uncertainties and open questions associated with it. And the question is would the Commission even accept such an approach.

CHAIRMAN KRESS: Good question.

MS. DROUIN: Okay.

MR. ROSEN: Hot dog.

MS. DROUIN: Where we are. We are planning on a two day workshop at the end of July.

We would like to come back to the full Committee in October and discuss, you know, in more detail these policy issues.

We are planning a paper to be issued to the commission at the end of December. And the purpose of that paper is to release this framework document for public review and comment. So we would like to then come back again in December and request a paper -- I'm sorry, a letter --

MR. ROSEN: You know we don't meet in January. If you miss December, you're going to be in February.

MS. DROUIN: I'm sorry.

MR. ROSEN: We don't meet in January, you know that.

MS. DROUIN: No. We want to meet you in December.

MR. ROSEN: So don't miss it, otherwise you'll be in February.

CHAIRMAN KRESS: You want a letter in October on policy issues do you think?

MS. DROUIN: No, we're not looking for a letter on the policy issues. This is just to keep you informed and to solicit -- we talked about coming to a Subcommittee, but we thought that we could do it at a full Committee.

CHAIRMAN KRESS: The policy issues I think you could. I don't know about the December, the one with the letter in December, maybe. You might be able to.

But I think we'll be happy to accommodate these things. Med is going out and doing work on it, so --

MR. ZEFTAWY: It should be no problem.

MS. DROUIN: We had originally thought to come in November for the full Committee. We've changed it to December because in November -- we can come in December and we'll have the SECY paper. If we come in November, we would not have the SECY paper.

MR. ZEFTAWY: I'm sure December is fine.

DR. WALLIS: You want some advice?

MS. DROUIN: I want to say recognize that what we're doing now is not a final framework in December. And I really want to emphasize that. This is a draft. So, I mean, we still anticipate probably maybe a lot of changes because up until this point we've had several meetings with the public, but they've been very high level. The first real meeting we'll have with the public will be in July. But it's really not until December that they're going to be able to get into the real depth of this. So that's really in my mind our first true engagement with the public on this.

And one of the things that occurred to

me this afternoon is that we had thought about our SECY paper in December providing recommendations to the Commission. And I'm going to revisit that with the team because I don't think we've given our time to interact with the public and get their input on some of these policy issues. And so maybe we don't go with the recommendation on the policy issues in December. We wait until after the public review and comment period and then go.

MR. KING: Yes, I think Mary's right. December would just be a heads up for the Commission; here are the policy issues we're working on it, we'll be in touch with you.

MR. ROSEN: I would think you're going to have a very vigorous discussion with the Committee when you talk about integrated risk, because as you know the Committee was --

CHAIRMAN KRESS: Yes. They'll eventually come to their senses.

But I see a lot of progress. I want to commend the progressive thinking. I think you're on the right track. I don't know how else you could have done this. I want to urge you to continue along this path. You're doing very well, I think.

The only real problems I have is, like I said, I have problems with the surrogates versus the F-C curve. And I still have that problem. I think the F-C curve with the curies is the surrogate, and you can't represent it by the ones you're talking about.

And also I had a little problem with the individual sequence AOOs and frequent acceptance criteria in since they're the same as the F-C curve which is supposed a cumulative. So there was a disconnect there.

But I wonder if some of the other Subcommittee members want to make any comments or they fell like they've already made enough. Any of you want to make some?

DR. WALLIS: I've got some. I think you've made a lot of progress. I was impressed by the writing and a lot of useful thoughts in here. A lot of progress since last time.

I think it should all be crisper and shorter. It's a high level document. It's not something which should waffle. And it should really make things very clear at a very high level so we have a framework. We don't just have a tremendous amount of stock. There's a guide for it in a way which is obvious.

I would like to see how it fits with the existing regulations. Now the existing regulations have been found to work and they make a lot of sense. And it's not some tremendous revolutionary change in going through this. Is there some way you can show that the regulations map into this framework in some way so that it's rational consolidation of lessons learned from what we do now, but it's now going to apply to a more general sort of reactors? Is there some way you can do that?

MS. DROUIN: Well, we had discussed that, that we thought it would be a good idea when we went through and looked at Part 50 and identified where they were technology-neutral, where they weren't to come back another time and map them. But that would be something that --

DR. WALLIS: But you say you have these very abstract diagrams with arrows going from box to box. If you could show how this actually is implemented in the present regulations. Because we have regulation blah-blah which does this action something, which sort of shows it's not just an abstract academic thing, but it actually relates to what we do now in a very definite way. That would help me.

MS. DROUIN: No, that we could easily do.

DR. WALLIS: That would help me.

MS. DROUIN: Because we actually did that--

DR. WALLIS: I think you have done of that, yes.

MS. DROUIN: We did that on option 3. We went through --

DR. WALLIS: Right.

MS. DROUIN: -- on option 3 and look at all the regulations and mapped them to the four cornerstone.

DR. WALLIS: Right. Right.

MS. DROUIN: Which are not too different from this.

DR. WALLIS: That would help me to say that it's not just some revolutionary thing dreamed up, but it actually is very logical extrapolation from what we do now. That would help me.

It would help me a great deal if you could use examples of some sort of simplified issues or simplified reactors to show how the framework helps you make decisions, how it would be used. And

I haven't really thought it out, but the business of how you trade off containment versus fuel integrity and so on.

We look at two sort of extreme reactors, how would they fit the framework or how would you reject a reactor because it was too extreme in one way or another or something. Look at a simple model reactor of some sort and show how the framework would enable you to make decisions of acceptance or rejection of various balances.

You talk about balance. Well, how you would reject. Give examples of cases where you would reject or accept and why.

MS. DROUIN: Yes.

DR. WALLIS: The exemplification really would help me.

MS. DROUIN: That is a test we have.

DR. WALLIS: Otherwise, I don't see how it's used. I don't see how these F-C curves are used either.

MS. DROUIN: That is a test we have assigned ourselves is to go through and do examples to the document.

DR. WALLIS: And another thing I feel is the real thing that matters is that eventually there are regulations. And I really see a long, long road from this very good thought document to reduction to practice where you actually have something that can be used. But that's really what matters, is that leads to that.

MS. DROUIN: It's where the rubber hits the road.

DR. WALLIS: Absolutely. And that's what it's got to do.

MS. DROUIN: Yes.

DR. WALLIS: And if you could show, perhaps, where at least some of this you're leading in that direction, wherein if you take this you get something really good at least in some part of it which can be used. That would, again, help me. Because, again, I'm being this academic, I want to be practical in how does it get used. That's where I'm a little suspicious. I think it may be a wonderful document but it may disappear unless there's a clear way to use it.

MS. DROUIN: The team will tell you that I have harped on that a lot to them. Because right now, I mean I know we have a lot in our heads, but I'm a big believer that if we turned over this document right now I don't think you could use this document to write these requirements.

DR. WALLIS: That's right.

MS. DROUIN: Chapter 6 is not there. Now, we recognize we have a long way to go in chapter 6, but chapter 6 is critical.

DR. WALLIS: But if you go really ruthless, I think when you go through this thing you and you start to rewrite regulations. You go back and say did these things that we talked about in this area really help us write these regulations. If they didn't, then throw them out because there may be a lot of superficial stuff in here or duplication, or something that you could get rid. Then it would be a much clearer, precise and useful document.

I'm thinking of something which is maybe a quarter the size or something. Then it would be easier for me to use. I wouldn't have to read all these words.

CHAIRMAN KRESS: Anybody else want to comment? You're welcome to.

DR. RANSOM: I just had a couple of comments. I guess in reading the document there were two things that I didn't really understand. One was the rationalist approach does not require a level 3 PRA and the other side of that, it also talked about risk-informed versus risk based. And I didn't hear those discussed today. I don't know if there's a reason for that.

MR. ROSEN: Well, maybe you could put those in the glossary or you could put some word -- I have a comment that's similar to that.

MS. DROUIN: I guess my question is that we don't define those or we did not discuss that we're trying to be risk-informed versus risk based?

DR. RANSOM: I just didn't understand why a level 3 PRA would not be required if you took the rationalist approach. Now, I understand that your proposing a structuralist plus rationalist sort of approach. All right.

CHAIRMAN KRESS: I think a level 3 is implicit whatever surrogates they use implicitly have the level 3 in it someway. So it's not thrown away, it's implicit in the surrogates. I just -- you know, I have problems with surrogates as being a true surrogate for the

DR. WALLIS: Well, how about the explicit statement level 3 PRA is going to be required for these reactors?

CHAIRMAN KRESS: No, I don't think you

want to do that.

DR. WALLIS: You don't like that statement?

MR. KING: We want to make the opposite statement.

MS. DROUIN: No.

CHAIRMAN KRESS: Yes, the opposite.

DR. WALLIS: Okay. We'll make the opposite statement.

MS. DROUIN: But I guess what I'm confused about --

DR. WALLIS: But I thought you were asking --

CHAIRMAN KRESS: No, no. What I'm asking for is an appropriate use of level 3 to define some surrogates. And I don't like the surrogates they got because I think the F-C curve is absurd.

DR. WALLIS: That's okay, too.

CHAIRMAN KRESS: Yes.

MS. DROUIN: But what was confusing me about your question is that whether or not you require a level 3 PRA, what does that have to do with being risk-informed or risk based?

DR. RANSOM: No, no. He said those two

separate things.

MS. DROUIN: Okay. I thought you were putting them together.

CHAIRMAN KRESS: I think the risk-informed is only self explanation. I mean, you got the defense-in-depth,, you're going to have design basis accidents, you're going to deal with uncertainties; all that's being risk-informed.

DR. WALLIS: Right.

CHAIRMAN KRESS: It's not just you make this QHO risk criteria.

DR. WALLIS: You do other things than just evaluate risk?

CHAIRMAN KRESS: Yes. Yes. So I think that's the difference between being risk-informed.

MR. ROSEN: I have one more comment.

CHAIRMAN KRESS: Go ahead.

MR. ROSEN: In 1.4 you define defense-in-depth with six or eight words. And I think you need to expand that definition a little bit.

MS. DROUIN: 1.4?

MR. ROSEN: It's section 1.4, the desired capabilities.

MS. DROUIN: Oh, that's not meant to be a definition of defense-in-depth

DR. WALLIS: An illustration of some of its attributes.

MR. ROSEN: But it's so sparse. Usually I complain about what's on the page, in this case I'm complaining there's not enough.

CHAIRMAN KRESS: And I still think you need the three regions for the advanced reactors.

DR. WALLIS: I don't like three regions. I think they either pass or they don't. And I think this waffle about an intermediate region where anything can happen and be negotiable is a bad idea.

CHAIRMAN KRESS: Well, if you do away with three regions, I think you have to do some confidence levels.

DR. WALLIS: Yes, that's okay.

CHAIRMAN KRESS: Yes. It may be to deal with it.

MS. DROUIN: But to me your three region approach was an easier way in my mind to get to what you waned because it was a three region approach within that safety goal limit.

CHAIRMAN KRESS: Yes.

MS. DROUIN: And then that would ensure that you did not go over.

DR. WALLIS: Well, maybe when you put in

the confidence levels it may look like a three region.

MS. DROUIN: Yes.

DR. WALLIS: But it's really a two region with confidence. That's okay, too.

CHAIRMAN KRESS: Yes.

DR. WALLIS: But I don't like the idea of a sort of a gray area where it's negotiable and NEI can come in or somebody could come in from some plant and waffle an excuse and get up somewhere to a higher level of risk than is acceptable.

MS. DROUIN: I agree. That's only acceptable below that line.

DR. WALLIS: Okay. Okay.

CHAIRMAN KRESS: Others? Steve? You want to say a few words?

DR. SHACK: No.

CHAIRMAN KRESS: Do you want to say something about the CDF for the site or --

DR. SHACK: No, no, no. I think the hardest thing here is the surrogate issue.

CHAIRMAN KRESS: Yes.

DR. SHACK: I sort of agree you don't want level threes. I'm not sure I like Tom's surrogate. I'm not sure I like -- it seems to me that is the issue and I don't know -- you have to think about that some more from all the suggestions here. I'm just not sure where it'll end up. But that seems to be a critical issue that you do want to end up with surrogates rather then level 3, and just how to do that is still an iffy thing. But it seems to me it's come a long way.

CHAIRMAN KRESS: All right.

DR. WALLIS: Can a surrogate be technology-neutral, is that part of the question?

MS. DROUIN: Yes.

DR. WALLIS: Can you really define it totally technology-neutral?

CHAIRMAN KRESS: Well, can you define surrogates that would meet all the regulatory objectives which are the F-C curves?

MS. DROUIN: Yes. I have one last question.

CHAIRMAN KRESS: Okay.

MS. DROUIN: On the schedule, you know this is what we have proposed coming back and interacting with the Committee. Does the committee see a need for us to come back?

CHAIRMAN KRESS: No, if that meets your schedule, that's fine with us. I think that's good.

Yes. Those look good.

So, I guess at this point I will declare this meeting adjourned.

Thank you.

(Whereupon, at 5:44 p.m. the meeting was adjourned.)