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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

542nd MEETING

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THURSDAY,

MAY 3, 2007

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ROCKVILLE, MARYLAND

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The Committee met at the Nuclear Regulatory Commission, Two White Flint North, Room T2B3, 11545 Rockville Pike, at 8:30 a.m., William J. Shack, Chairman, presiding.

COMMITTEE MEMBERS PRESENT:

WILLIAM J. SHACK	Chairman
SAID ABDEL-KHALIK	Member
GEORGE E. APOSTOLAKIS	Member
J. SAM ARMIJO	Member
MICHAEL CORRADINI	Member
THOMAS S. KRESS	Member
OTTO L. MAYNARD	Member
DANA A. POWERS	Member
GRAHAM B. WALLIS	Member

ACRS STAFF PRESENT:

JOHN GROBE
PAUL LOESSER
MIKE WATERMAN
BILL KEMPER
STEVE ARNDT
RICK CROTEAU
MARY DROUIN
MARTY STUTZKE
JOE BIRMINGHAM
EILEEN McKENNA
JOHN MONNINGER
CHRISTIANA LUI
DON HELTON
NATHAN SIU
ROB TREGONING
BRIAN SHERON
STU RUBIN

ALSO PRESENT:

KIMBERLY KEITHLINE
TONY HARRIS

I-N-D-E-X

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

(8:31 a.m.)

CHAIRMAN SHACK: The meeting will now come to order.

This is the first day of the 542nd meeting of the Advisory Committee on Reactor Safeguards. During today's meeting, the Committee will consider the following: digital instrumentation and control system matters, Commission paper on staff's recommendation to make a risk-informed and performance-based revision to 10 CFR Part 50, status of the development of an integrated long-term regulatory research plan, ACRS members' issues associated with the technology neutral framework for future plant licensing, and proposed ACRS reports.

This meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act. Mr. Sam Duraiswamy is the Designated Federal Official for the initial portion of this meeting.

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

A transcript of portions of the meeting is being kept, and it is requested that the speakers use one of the microphones, identify themselves, and speak with sufficient clarity and volume so they can be readily heard.

I will begin with some items of current interest. One thing, I note that we have a package on items of interest, and there's a number of speeches from the Commissioners in there, including one from Commissioner Lyons on computer modeling and simulation, something that many of the members have interest in.

There is also a number of interesting SRMs on security assessments and the proposal to include aircraft impact design requirements for new reactors, and we are going to look at those.

We are going to have a training session today on the use of the bank card for members between 11:30 and 11:45, so don't run away.

PARTICIPANT: No, that's tomorrow.

PARTICIPANT: That's Friday.

CHAIRMAN SHACK: That's Friday, on Friday. I'm sorry.

MEMBER MAYNARD: I have a day to prepare now.

(Laughter.)

CHAIRMAN SHACK: It's the travel card.

MEMBER WALLIS: That's the regular one we all have?

CHAIRMAN SHACK: Yes.

MEMBER CORRADINI: Which we don't use.

CHAIRMAN SHACK: Well, that's what we will be trained on.

The other item is this is the last full Committee meeting for Ralph Caruso, a staff member. He has been with the NRC for 27 years and four years with the ACRS staff, and he will be retiring on June 1, 2007. Mr. Caruso has provided outstanding technical support to the Committee in reviewing numerous complex technical issues in the areas of thermal hydraulics, reactor fuels, extended power uprates, and PWR sump performance.

His detailed knowledge of the regulatory process and technical issues have been very helpful to the Committee in its review of several matters. His dedication, hard work, attention to details, ability to identify significant issues of importance to the Committee, his outstanding contributions and loyalty to the Committee, are very much appreciated.

We would like to thank Ralph and wish him good luck on his future endeavors. He has some interesting plans for retirement.

(Applause.)

MEMBER POWERS: Well, that is just a provocative ending statement.

(Laughter.)

CHAIRMAN SHACK: We will just leave it there.

Our first topic this morning is digital instrumentation and control system matters, and George will be leading us through that.

MEMBER APOSTOLAKIS: Thank you, Bill.

You will recall that we met with the Commission last October, and the issue of digital I&C was raised by the Commission. Following that meeting, we received a staff requirements memorandum where it was stated that the Committee should provide its views to the Commission staff's effort related to digital instrumentation and controls. The Committee should consider potential means for providing reasonable backup, if appropriate.

So the purpose of today's meeting is to review what the staff is doing in this area, and then write a letter during this meeting responding to the Commission's SRM.

There was a Subcommittee meeting on April 18th. We had Said present, Tom, and Mario, and me, where we had presentations by the staff, more detailed presentations than what we will hear today, on what is happening. And I must say there will be a lot of new stuff this time for the full Committee, because now that there is an expressed interest from the Commission, things are happening at the higher level and we'll hear about the Steering Committee that was formed. So --

MEMBER MAYNARD: For the record, I was at the meeting also.

MEMBER APOSTOLAKIS: I'm sorry.

MEMBER MAYNARD: That's all right.

MEMBER APOSTOLAKIS: I'm sorry. You were, yes. Otto was there.

Okay. So without any further ado, I will turn it over to the staff. Who will be the -- Jack?

Yes, I'm sorry, Otto.

MEMBER MAYNARD: I just wanted to get it on the record, George.

MEMBER APOSTOLAKIS: Next time I should write the names down.

Oh, yes, NEI goes first. I'm sorry, I'm sorry, I'm sorry, I'm sorry. Boy, I'm sorry all the time.

(Laughter.)

MEMBER CORRADINI: Do you need some coffee?

MEMBER APOSTOLAKIS: So we have Ms. Keithline, right?

MS. KEITHLINE: Yes. And Mr. Tony Harris.

MEMBER APOSTOLAKIS: Okay.

MS. KEITHLINE: Good morning. I'm Kimberly Keithline. I've been at NEI now for almost a year. I came from the Naval Reactors Program. Tony and I, on behalf of the nuclear industry, appreciate the opportunity to be here this morning, as well as we also appreciate the opportunity to participate with the staff on the efforts that they are going to describe to you over the next couple hours.

These efforts to resolve issues related to digital instrumentation and control and human factors are very important to the nuclear industry, especially with the resurgence of nuclear power and the new plants that are coming along. We also recognize, though, that they are very important to existing plants, where people are realizing the need to upgrade from analog systems to more modern digital systems.

We recognize that the scope of these efforts is very large, and that there are resource constraints, both at the NRC and within the industry.

So we are working with the NRC staff to prioritize our efforts, to look at which ones are most urgently needed. And during the month of May we will be working closely with them in six different groups to focus our efforts and prioritize our actions for resolving them.

MEMBER APOSTOLAKIS: What criteria are you using for prioritization?

MS. KEITHLINE: We're looking at what the industry's needs are near-term for both new plants and existing plant upgrades, what key decision points are coming along at various times that -- where this additional improved guidance may be very valuable in helping both the industry and the NRC through the review process. So we are trying to get input from vendors and utilities about what their real needs are.

MR. HARRIS: Yes. Dr. Apostolakis, Tony Harris, NEI. A lot of what we're trying to do is to -- in herding our cats -- is to find out from each individual what they are actually planning on doing, what kind of technology they are planning on using, and what kind -- when and what type of submittals they will be making. A lot of it is for new plants.

We have a little bit of a unique challenge, both from a staff perspective and from our perspective, that we are having to deal both with new plants and existing plant upgrades. But to look and see what is coming down the horizon from the near term and what type of technology and more unique designs might be put forward.

MEMBER APOSTOLAKIS: Are you also thinking in terms of some longer term research?

MR. HARRIS: Yes. Yes, we are.

MS. KEITHLINE: Yes. Although --

MEMBER APOSTOLAKIS: Kimberly is not so sure.

MS. KEITHLINE: Well, much of the effort right now is focused on defining what is really needed near term, but we do recognize that there are long-term needs, especially from the standpoint that going digital is not going to solve the obsolescence issues, so there will be a need to continually deal with obsolescence. And in the digital world that may be different from the analog world.

Most of our efforts so far have been focused on the "what's needed very soon" just to get through the new plant COLs that are coming up.

MEMBER APOSTOLAKIS: Okay.

MR. HARRIS: But you will -- Tony Harris again, NEI. You will see in the project plan some longer term items, including research initiatives.

MEMBER APOSTOLAKIS: Which project plan is it?

MS. KEITHLINE: The NRC's project plan that --

MEMBER APOSTOLAKIS: Oh, the NRC I know. I'm talking --

MS. KEITHLINE: Yes.

MEMBER APOSTOLAKIS: -- about you. I know what the NRC does.

MS. KEITHLINE: Oh. The way we're working this project is that the NRC owns the plan, because it's their efforts, and they have been very good about asking for our input, suggestions, feedback into their plans. So it's almost a joint plan, but technically not so because they need to maintain their independence.

MEMBER APOSTOLAKIS: So they are paying for it to be independent, right?

MS. KEITHLINE: I'm sorry. They are?

MEMBER APOSTOLAKIS: They are paying for it.

MR. HARRIS: I think we wind up paying for it in the long run, so I -- I saw my bill.

(Laughter.)

MEMBER APOSTOLAKIS: Okay. Let's go.

MS. KEITHLINE: Okay.

MEMBER APOSTOLAKIS: It's interesting, though, you are not having any separate efforts at this point.

MR. HARRIS: No, we do. Through EPRI we have a Digital I&C Subcommittee that is working on other efforts as well. And what our focus is is to try to look at the needs. If they hit the regulatory space, then we look for opportunities to collaborate with the staff and not duplicate efforts.

MEMBER APOSTOLAKIS: So there are research projects going on sponsored by EPRI.

MR. HARRIS: Yes.

MEMBER APOSTOLAKIS: Okay. That's good to know.

MS. KEITHLINE: I would like to point out we had a meeting yesterday, an NRC public meeting, with their Steering Committee. And it was a very productive meeting I think. We identified several things that we need to do in the very near term. We've got a lot to do with them, and among the industry, in the next month to really prioritize our efforts and actions and lay out exactly what is going to happen.

One concern that I have is that we discussed -- given the resource constraints and the timing issues, it may be necessary in some cases to take a two-step approach, to take a conservative approach to the first step, maybe issue some guidance that is more conservative than we all want to eventually up with. And then, over the next months, years, come up with maybe more flexibility in terms of how we could approach some of these issues.

I understand why that may be needed. We need to keep in mind as we consider that option that the new plants in particular are trying very hard to standardize their plants. And so we'll need to think carefully about which ones the two-step process will work for and where that may not be very beneficial because if they design to the much more conservative approach they are probably not going to have the near-term opportunity to upgrade things if they are trying to maintain standardization.

MEMBER APOSTOLAKIS: Now, why did you say that's a concern of yours? The NRC staff doesn't want to do it that way?

MS. KEITHLINE: No. One idea that has been presented --

MEMBER APOSTOLAKIS: Oh, it's just being

discussed. I mean, there's no disagreement about it, because it sounds reasonable to me that you do have --

MS. KEITHLINE: It's reasonable as long as it doesn't -- it may not be practical in some regards for new plants.

MEMBER APOSTOLAKIS: Oh, okay.

MS. KEITHLINE: That's the concern.

MEMBER APOSTOLAKIS: Okay.

MS. KEITHLINE: That's the concern. But it's just something that we've started discussing, and I think we need to think very carefully about as we go forward. That's al.

MEMBER APOSTOLAKIS: Thank you.

MS. KEITHLINE: Yes. Anything else?

MR. HARRIS: No, I think that's all.

MS. KEITHLINE: That's all. We don't want to take up much time, because we know the staff has a lot to cover with you this morning. If you have any other questions, we'd be happy to answer them.

MEMBER APOSTOLAKIS: But at the Subcommittee meeting, though, you also talked about other things. What are your views on this diversity and defense in depth issue? I mean, that's a hot item. I mean --

MS. KEITHLINE: That's --

MEMBER APOSTOLAKIS: -- do you agree with the way the staff is going, or you are reserving judgment, or what? Where are we?

MS. KEITHLINE: To some extent, we are reserving judgment. The staff -- we have -- we believe this is a very important issue, diversity and defense in depth. The staff has some near-tern research underway that they intend to help them -- that will help develop some more objective review criteria for diversity and defense in depth evaluations.

We think that is very important. Over the next few months, that will be coming together, and we've got at least one, maybe more, vendors, utilities, interested in providing some test cases, their design concepts, that could be tested against some review criteria to see both how well those new review criteria help the NRC and how well they work with industry. And we think that's a very important effort.

MEMBER APOSTOLAKIS: So this fits nicely in your earlier concept of a two-step approach. It seems to me this is a conservative thing to do, so we'll have something in five months that will be a first step. And then, in the longer term, we'll probably refine this?

MR. HARRIS: I think --

MS. KEITHLINE: Well, the problem with that -- a potential problem with that is that if -- taken to an extreme, you know, the ultimate conservative approach for diversity and defense in depth could be to require -- and this is just a possibility -- a complete diverse actuation system with all of the safety and protection functions, and make that an analog system. That would be one extreme that would definitely be conservative from a diversity standpoint.

Now, is that maybe the best longer term solution for a new plant? It might not be. But if the plants need to design their new plants that way now, it's going to be very difficult for them to change over the next few years while they are trying to maintain standardized approaches to their plants. It will be more difficult for utilities to decide to upgrade later on.

MR. HARRIS: I think that -- Tony Harris at NEI again. I think what we're trying to do is to -- to the extent practical, develop what would be a reasonable approach. And we recognize, you know, coming in from a nuclear standpoint, from a commercial nuclear power industry, there is not in the United States a whole lot of history. But there are other industries, and to the extent we can learn from them, and understand how they've addressed diversity, we have to do that, and we have to take advantage as much as possible without ultimately retrofitting.

MEMBER APOSTOLAKIS: Mr. Harris, I've been hearing this, not necessarily from you, for three years now. And I never see any slide that says, "And this is what we learned from other industries." When is this happy day going to come?

(Laughter.)

That's my major complaint. I mean, there is all of this history out there, and we don't see a systematic review that says, "This is what happened at Ariane 5. These are the lessons learned, but they don't apply to us because ..." or "they apply to such and such a system in nuclear facilities because ..." Unless we do that, it seems to me we'll always be talking at the 10,000-feet level. Is that something that EPRI is doing right now?

MR. HARRIS: Yes. One of the things that we have as an industry talked about and have been working on is a plan to look back through history and research.

MEMBER APOSTOLAKIS: That would be extremely valuable, I mean, if you guys are doing it. Mr. Marion --

MR. HARRIS: I would also say, sir, that in a couple of the research projects there are similar aspects, and we are --

MEMBER APOSTOLAKIS: Yes.

MR. HARRIS: -- looking to collaborate with the staff on those as well.

MEMBER APOSTOLAKIS: Absolutely.

MR. HARRIS: So it's really important.

MEMBER APOSTOLAKIS: Now, last time at the Subcommittee meeting, Kimberly, you and Mr. Marion said that there will be a series of technical papers coming out of your shop in the next few months on the issue of diversity and defense in depth?

MS. KEITHLINE: Right. And in some of the other areas, recognizing that there are resource constraints at NRC, we're willing to provide recommendations, white papers, where it may be helpful. And in the area of diversity and defense in depth, there are I think eight problem statements, so several areas we are trying to address.

MEMBER APOSTOLAKIS: So you are already doing this.

MS. KEITHLINE: And we have started working on some of those yes. We're meeting with the staff and the task working group next Wednesday to go through each problem statement and make sure we've identified who is doing what, when it's going to happen, and how we're going to get to the end states on those.

MEMBER APOSTOLAKIS: Well, that would be great. I hope at some point you will brief the Committee as well.

MS. KEITHLINE: Okay.

MR. BANERJEE: Well, what are these eight problem areas?

MR. HARRIS: Which ones, the --

MS. KEITHLINE: For the diversity and defense in depth? And I think the staff -- is the staff going to go --

MEMBER APOSTOLAKIS: The staff will go over it in detail.

MR. BANERJEE: Oh, they will?

MEMBER APOSTOLAKIS: Yes, it's the staff's definition.

Are there any questions for the NEI representatives from the Committee?

MR. HARRIS: And, again, let me -- I'd

point out, if you look through the staff's plan, each of these task working groups, it's not just limited to those eight in diversity. There are others that are pretty significant items, including one I would bring your attention to in human factors. And it basically goes between communications and human factors, and that's the use of both safety and non-safety information on video display units, how that would go about. Is it even acceptable that we would control safety-related components or systems from the non-safety VEU, so --

MEMBER APOSTOLAKIS: Great.

MEMBER POWERS: Why is that a question?

MR. HARRIS: Why is that a question? It's a matter of, first off, should you do it, you know, from a operations standpoint. Secondly --

MEMBER POWERS: Well, the answer is unequivocally no, see? So now, why is that a question?

MR. HARRIS: Well, why would it be a no? That's what we would --

MS. KEITHLINE: It's a question, because some of the vendors are currently designing systems for new plants that would do some of that.

MR. HARRIS: Right.

MS. KEITHLINE: And so it's an issue that needs to be addressed.

MEMBER POWERS: Always had absolute separation between safety and control. That has been done since HT-1 accident.

MS. KEITHLINE: And that's one that we definitely need to converge on, whether the answer is yes, no, or something --

MEMBER POWERS: The answer is no now. Why would you raise that -- why would you raise -- I mean, how do you approach the question in anything except the answer being no? I mean, I know of no counterexample.

MS. KEITHLINE: And that's one where we're really getting started on writing up the why it would be useful and what the issues would be that would need to be resolved. It's one where the vendors -- some of the vendors have started heading down that path, so we feel that it's one that needs to be resolved somehow, and the answer --

MEMBER POWERS: There has to be some basis for thinking that you could resolve it. I mean, what did I tell you? I said the answer is no, because I know absolutely that we have always demanded separation between safety and control.

Now you're telling me you're going to bring them together. Maybe not the most important -- bringing them together -- but certainly bringing them together, why would you think you can -- I mean, what is the philosophical basis that says this is okay?

MR. HARRIS: The philosophical basis -- you know, from an operator standpoint, certainly moving from panel to panel in a human factors arena --

MEMBER POWERS: I mean, that's what I'm looking for is to say --

MR. HARRIS: Right.

MEMBER POWERS: -- okay, it's a bigger hazard to have this guy moving between two screens or --

MR. HARRIS: Yes.

MEMBER POWERS: -- something like -- how do you know that?

MEMBER MAYNARD: Well, I think in other industries that it found that once you're able to go to the --

MEMBER POWERS: Do you know of any industry that can contaminate land for thousands of years?

MEMBER MAYNARD: Yes. As a matter of fact, a particular one -- military, aviation. There's

-- you've got the chemical industry.

MEMBER POWERS: I know of no chemical that can survive the environment for thousands of years. Reactive chemical.

MEMBER MAYNARD: But there are -- I'm not going to go into the military aspects and stuff, but there are other aspects that can. But I still say that with the later technology and different things that sometimes you can actually improve safety by incorporating some of the things and doing some things different than maybe you've done in the past.

I don't think it should just be a closed subject where you just say a flat no. I think that it would require a lot of justification, and I think that needs to be justified.

MEMBER POWERS: And I'm asking them how they're going to go about doing the justification, and he started down a path that seems promising to me. And he says, "Okay. Well, I've got a guy going between two screens. It's not as safe as the guy just working one screen." And I asked, "How do you know that?"

MEMBER MAYNARD: Well, a lot of it is based on some human factors research. I don't have all of the information in front of me right now. We can bring that -- if you'd like to have that as a topic, we can bring the right folks here for you. I'd rather do that than --

MEMBER APOSTOLAKIS: Okay. Any other questions?

(No response.)

Thank you. You kept up with the NEI tradition of not having any handouts, I see. That's --

MS. KEITHLINE: That's right.

MEMBER APOSTOLAKIS: Now we go to the staff.

MR. GROBE: Good morning. My name is Jack Grobe. I'm Associate Director in the Office of Nuclear Reactor Regulation for Engineering and Safety Systems. Previously, you have been comfortable with Brian Sheron here. I'm just a little bit smaller and a little bit grayer.

We're going to talk about two subjects in detail, some detail today, but the Subcommittee requested that we give somewhat of a broad overview of what the Steering Committee is all about, why it came into existence and how it's functioning. I'll provide that brief introduction, and then turn it over to the staff to discuss in more detail digital issues and risk issues.

I'd like to introduce the staff that's here today -- Paul Loesser from NRR, Mike Waterman from Research, and Steve Arndt from Research. We provided you two documents ahead of time, a set of slides. There's a tremendous amount of detail on the slides, of course not as much as we went through with the Subcommittee. But I'm asking the staff to try to limit their presentation on the two detailed subjects to 30 minutes to allow for approximately 30 minutes for questions and answers. I'm not planning on going through all of the detail that's in the slides.

We also provided you a draft of the project plan that the Steering Committee is developing. It is broken up into six subcategories. We call them task working groups, and there is details under each of those task working groups of the specific problems that we're refining and what our plans are to deal with those.

Last November, we met with the Commission to discuss digital instrumentation and control. The Commission also met with a panel of the industry folks to discuss their questions and concerns and issues regarding digital instrumentation and control. Following that Commission meeting, we received a staff requirements memorandum that provided direction to form a Steering Committee.

The purpose of the Steering Committee was to gain alignment with the industry on what the issues are, to assess what might be the critical path, particularly for new reactors and operating reactor retrofits, and address certain technical issues. At that Commission meeting, I believe there were three issues that were causing significant concern for the industry that they expressed. One was a very substantial retrofit at one nuclear plant that was under review. That review was proceeding, but was very complicated.

Secondly, some level of anxiety regarding preparation for new reactors, particularly completion of simulators, control room simulators, to support operator training. If you talk -- if you start with the day they anticipate completing construction and beginning operation, and you start backing up the dates, you come to late this decade when the simulators have to be functional.

And there was a third issue that I just lost. It will come back to me. It's a senior moment, I apologize.

But the Steering Committee was formed by the Executive Director for Operations in January. This not only affects new reactors and operating reactors but also affects fuel cycle facilities, and as well as our security issues. So there are senior executives from all five of the major program offices -- NMSS, NSER, NRR, NRO, and Research -- on the Steering Committee.

Slide 6 contains the members of the Steering Committee. I chair the Committee. Mike Mayfield, Director of Division of Engineering from NRO, is on the Committee; Mark Cunningham, Director of the Division of Fuel Engineering and Radiological Research is on the Committee; Joe Gitter, Deputy Director of Fuel Cycle and Safety and Safeguards, from an NMSS perspective; and Scott Morris, Deputy Director, Division of Security Policy from a cyber security perspective rounds out the Committee.

The purpose of the Committee is to interface with the industry, ensure that we have a clear understanding of what the issues are with respect to retrofit and licensing of digital control systems in our licensed facilities, to ensure that the offices are effectively coordinating on resolution of these issues, oversee the resolution of technical issues, promptly identify any policy or regulatory roadblocks to resolution of the issues, and monitor the line organization's implementation of the resolution of these activities.

The Committee has forced six what it calls "task working groups." Each of these task working groups is led by a manager in the appropriate program office, has a number of staff from the appropriate program offices supporting the task working group.

You can see on this slide the titles of the various task working groups. They have conducted multiple public meetings with the industry to help refine the problem statements that are contained in the draft project plan, ensure we get input from the industry on what their concerns are.

I want to emphasize that our current licensing guidance and standard review plan is adequate and has been used effectively to license the application of digital technology at nuclear plants. The challenge is that it's in some particular technical areas, most notably communications, diversity and defense in depth, and risk.

The guidance is not specific enough, as this technology is evolving rapidly to give predictable guidance to the industry on what the staff views as acceptable and what may not be acceptable.

And as I mentioned earlier, one plant is going through a significant retrofit of their reactor protection system and emergency core cooling system instrumentation and control, essentially a complete replacement with digital upgrades.

And in going through that review process, it became clear that we could be more predictable for the industry and more efficient for our staff if we had additional guidance in these areas. So this whole effort is to make us more predictable and efficient and effective. There is no concern with the safety of the current retrofits that are in our operating reactors today.

As Kimberly mentioned, the industry has been supporting each of the TWGs with a variety of staff from utilities, EPRI, vendors, to ensure that we have clear understanding of what the industry's issues are -- industry's issues are, and we're addressing them appropriately.

MEMBER APOSTOLAKIS: Before we leave this, I think there is, as I said earlier talking with NEI, there is a box that it seems to me affects all six of these boxes. And personally, I would like to see it emphasized. And this is the identification of potential failure modes based on the experience from other industries and our experience.

Maybe it's buried, some of it, under risk-informed digital I&C. But I don't see how you can do a diversity and defense in depth evaluation without understanding the failure modes.

I really think you ought to pay attention to it, much more than the attention it's getting now. And maybe have a box of -- a dependent cause for all of these, feeding into all six boxes possibly, understanding how things can go wrong. I mean, that's the most fundamental thing -- trying to understand how things -- because, you know, there is some work out there. There is a lot of analysis and evaluation of what happened in other industries, especially NASA and the European applications.

But as I said earlier, I don't see a lessons learned document that says, you know, this is what happened, there was a combination of human error. The poor software appears to always do what it was designed to do. It's just the context within which it operated that led you to do something that turned out to be wrong.

So I really think we would benefit from this. In fact, I would call it a near-term need to do it as quickly as possible, draw these lessons, and then start talking about the three Ds and other things.

MR. GROBE: Appreciate your question. It isn't buried, but it is part of the risk-informed digital I&C task working group. Office of Research has an extensive research plan in the digital I&C area. I hope the Committee has a copy of that. If not, we'll make sure that you get it. And part of that is identifying failure modes and effects for digital.

One of the challenges that we face, and Kimberly mentioned it, is that we have new reactor applications that are expected to be in-house later this year. Many of these issues are going to require more than several months worth of work to resolve, and there's a very close relationship between risk, communications, and defense in depth.

And it may strategically be more appropriate to insist on a diverse independent backup system to deal with some of the uncertainties where we're still doing research and we won't have these questions resolved for a year or two years. So those are the particular interrelationships between the various task working groups that the Steering Committee is thinking about.

MEMBER APOSTOLAKIS: But my suggestion is to give it more importance. I know there is some work going on, but to give it more importance and show it on a slide like this.

MR. GROBE: Okay.

MEMBER APOSTOLAKIS: Because, for example, if the context that involves other failures leads the software to do the wrong thing, it's not clear to me that if I have diverse software, they would not all do the wrong thing, if something else is the driver.

If the inputs are the driver, you know, if you have different manufacturers, separate, they may all end up doing something that's wrong. I don't know whether that's true. From what I'm reading, it might be. So that's what I'm saying. Give it more importance, if you could.

MR. GROBE: Okay. Thank you.

MEMBER APOSTOLAKIS: Okay.

MR. GROBE: On the next two slides I've just listed the task working groups and a brief statement of what their focus is. As you notice, there is nothing under diversity and defense in depth and risk-informed digital I&C. That's because at this point I think I'd turn it over to the staff to discuss those two areas in more detail.

MEMBER APOSTOLAKIS: Why is the last bullet important? Or was --

MR. GROBE: Licensing process?

MEMBER APOSTOLAKIS: Human factors engineering regulatory guidance.

MR. GROBE: I'm sorry.

MEMBER APOSTOLAKIS: Is that something that is very important at this point? It might be; i'm not saying it's not. But, I mean, considering the other issues that you have to face --

MR. GROBE: The transition from a traditional control room to a digital control room involves, of course, different human factors issues, man-machine interface issues. And those issues have to be resolved.

As far as priorities, in my mind, on the short term, to support the retrofits that we anticipate this year and the new reactor applications we anticipate this year, the most important of these is diversity and defense in depth.

MEMBER APOSTOLAKIS: Yes.

MR. GROBE: And the industry is working hard now on prioritizing these and making sure that they have the input that we need on what their priorities are and what their timeframes are.

MEMBER WALLIS: But this final bullet, this human factors control room, is that something that's new because of I&C, or do you have already a lot of guidance about human factors in the control room?

MR. GROBE: We have plenty of guidance on human factors in the control room. Much of it is not sufficient to provide clear guidance for how to apply those concepts in a digital environment.

MEMBER WALLIS: Something different about I&C, digital --

MR. GROBE: Oh, yes. Instead of your traditional panels and annunciators -- I was up in Pennsylvania yesterday at Westinghouse and saw a demonstration. They had a scaled-down version of the control room simulator. It's not fully modeled yet, but the two engineers worked through a steam generator tube rupture, and neither one of them left their chair -- the reactor operator and senior reactor operator. A very, very different environment.

MEMBER WALLIS: It all seems better.

MR. GROBE: There is tremendous advantages to digital technology, as far as the efficiency of activities in the control room. But it raises questions regarding our guidance on how to apply the guidance we have for traditional control rooms to a new environment.

At this time, I'd like to turn it over to Paul and Mike to talk about diversity and defense in depth. And as I mentioned, we'll try to keep their comments to 20 minutes or so.

MR. LOESSER: I think we can do that. First of all, our safety concern --

MEMBER APOSTOLAKIS: I forgot, I'm sorry -- I have another question. And I'm willing to be corrected, by the way. The last three years or so every time we meet with the staff to discuss digital issues there is always a plan to be reviewed. And that's what we're doing today as well.

When will these plans start producing something? Is that why the Steering Committee was formed, to give it more momentum? Because, you know, two years ago -- about two years ago the Committee wrote a letter on a digital I&C plan, and we said we liked it, as I recall. Two years later we are presented with another plan.

I mean, I have seen progress, by the way, in all fairness, in the risk-informed part. I mean, we had the presentation, and we have another one today. Is it because you don't think the Committee is interested, so we are not presented with progress in other areas? Or, I mean, when will we stop hearing about the plan?

MR. GROBE: I have not known the Committee to not be interested in any topic, so we're certainly willing to present the results. The plan you refer to was the research plan that I mentioned earlier, and that's an extensive research plan. There has been work underway. I think the Subcommittee heard a little bit of the results in its last meeting, and we're going to provide -- some of our presentation today includes results of that research.

The Steering Committee was formed to ensure that all of the offices were effectively integrated. Two years ago, we had a research plan. Two years ago, we didn't have any combined operating license interest. November of 2005, it appeared that we might get three combined operating licenses. Now we're an order of magnitude higher than that.

So the need for prompt, integrated resolution of these issues has taken on a much higher priority, and that's the purpose of the Steering Committee -- to ensure all the offices are effectively integrated in bringing these issues to closure on a timely basis.

In the draft project plan you have there is what I would refer to as a set of Level 1, high-level milestones and deliverables. There is no due dates in the project plan, and we have -- the task working groups have been working on dates for resolution of each of these. Most of the short-term due dates are this year.

And the public meetings that each task working group is going to be conducting this month will be to refine those due dates, make sure they're achievable and appropriate to meet the needs of the industry and the staff. And we'd be glad to meet with you on a regular basis to discuss progress.

MEMBER APOSTOLAKIS: I think that would be a good -- we'll start with Subcommittee if necessary.

MR. GROBE: Okay.

MEMBER APOSTOLAKIS: Okay. Thank you.

Paul?

MR. LOESSER: Back to me. When considering our safety concern, there was a November 8th SRM to the ACRS where you were asked to take a look at digital instrumentation and consider the possible means for providing reasonable backup, if appropriate.

Our concern is that if an error in common software could cause all channels to the protection systems to fail in those channels where this software is being used. Consolidation of many safety functions into a single four-channel system increases this concern. You would now lose not only one protected function but possibly many.

We still consider that high-quality software --

MEMBER APOSTOLAKIS: On this point, though, again, it's not clear to me what it means, though, that software will malfunction, because if I look at the operating experience it does not malfunction. It does what it's supposed to do. It's getting the wrong inputs.

So unless we really look at the past experience and draw some lessons, it seems to me we will not have a very solid approach with the D3 issue.

I don't -- why should the -- I mean, there are some instances where the software itself malfunctions, but if you look at the major accidents the whole thing does whatever it's supposed to do. But somebody forgot something, somebody -- you know, some sensors failed.

MEMBER ARMIJO: Somebody changed something.

MEMBER APOSTOLAKIS: Sorry?

MEMBER ARMIJO: Well, it does if somebody changed something.

MEMBER APOSTOLAKIS: Somebody changed something. So you say that it malfunctions. I don't understand this. I mean, this is --

MR. LOESSER: In many of the cases, it does what the programmer designed it to do, but that may not be what the plant had intended it to do due to a misunderstanding of the requirements. There have been some just flat programming errors where someone made --

MEMBER APOSTOLAKIS: Sure.

MR. LOESSER: -- a mistake.

MEMBER APOSTOLAKIS: Yes.

MR. LOESSER: There have been cases where there are unanticipated instances, as you point out, something they didn't consider when they wrote this program, and that puts it into unknown space and the program is now being asked to handle something that was not considered.

MEMBER APOSTOLAKIS: So you are calling all of these malfunctions?

MR. LOESSER: Yes. And we're not --

MEMBER APOSTOLAKIS: It's not just

software that --

MR. LOESSER: We're not trying to -- we're not trying to isolate it at this level. What we're trying to say is things can happen where the intended safety function does not occur.

MEMBER APOSTOLAKIS: Ah, that's -- yes, exactly. And that's where, again, you can draw a lot of lessons.

MR. LOESSER: And this can happen in all four channels at the same time.

MEMBER APOSTOLAKIS: I agree.

MR. LOESSER: Whereas, in the older analog systems, it tended to be wear, so you would lose one channel at a time. With these, if you consider a common mode failure, you can lose it all. And if you put all your safety functions into one system, you could conceivably lose every safety function in the plant all at the same time due to a malfunction.

MEMBER ARMIJO: Have you reviewed the operating experience of the more modern Japanese plants who have used digital I&C for a long time to see what their experience has been, what kind of errors they've had that are unique to digital systems versus --

MEMBER APOSTOLAKIS: Yes.

MEMBER ARMIJO: -- analog systems and gotten some lessons from them that --

MR. WATERMAN: This is Mike Waterman. I'm in the Office of Research, and I'm the Program Manager for our diversity research we're conducting now. Is this May? Yes. Later this month I'm going to Europe to talk to European regulators about their experience with diversity and common cause failures and their plants, and later this year I believe I'm slated to head west to talk to the Japanese, the Koreans, Thai Power, and our counterparts over in those countries to find out how they're doing.

So have we done it yet? No. Are we planning on doing it in the very near future? Yes, we are.

MEMBER ARMIJO: I would urge you to do it right away, because that's real experience.

MR. KEMPER: If I could offer -- this is Bill Kemper from the Office of Research. We also have an international conference planned right here in June, June 19th through 21st. We've invited over 30 countries to come in and talk specifically about this issue -- common cause failures associated with digital systems, experience in their nations with their nuclear programs, etcetera.

MEMBER APOSTOLAKIS: But it would be nice, before we take any major action on the diversity issue, to have a document someplace, a NUREG or something, that has a list of past incidents in the space industry, in the nuclear industry, and other industries, a description of those to the extent possible, and some lessons learned and possible transfer -- possibly transferring these to the nuclear industry.

I think that will be extremely educational, because, I don't know, some of you guys have a lot of experience and a lot of things come to your mind. But I think having things like that on black and white, I mean, it will really help everybody.

And then, we can address issues of what it means that the software malfunctions, what it means that we may lose all the functions, what it means -- and another thing is I really like this idea that ATHEANA has promoted of the error-forcing context, because I think these things here lead to some malfunction as a result of the whole context or the whole sequence of what is happening.

So talking to those guys for five minutes wouldn't hurt, by the way, and -- but it would be nice to see such a white paper. I mean, and, Bill, I know how these conferences are. I mean, people will come, they will -- may give you one example. They may talk about it. But, I mean, a systematic evaluation -- Brookhaven did something for you sometime ago.

You can build on that and go into more detail, so there is a basis. I mean, it's not -- they collected a lot of information, as I recall, and they drew some conclusions. But going more deeply into the failure modes would really be a great thing.

Steve? I'm sorry.

MR. KEMPER: I'm sorry. It's Bill Kemper again. I just wanted to amplify on what you just said, George. In conjunction with nuclear sector, we're also indicting other non-nuclear sectors as well to speak at this international conference. And we intend to have a specific sit-down discussion before and after the meeting with the international participants to really get into the details of their experience in common cause failure.

MEMBER APOSTOLAKIS: You can ask them to give you information as to where you can find actual descriptions of what happens.

MR. KEMPER: Exactly. And, of course, you know about COMSYS, you know, the COMSYS, the international program.

MEMBER APOSTOLAKIS: It's really a great thing to have.

MR. WATERMAN: The other usefulness of that approach, Dr. Apostolakis, is the errors can generally be classified as a specification error. When you nail it down, well, this was an error in specification, this was an error in implementation, this was an error in design also, once we get a handle on where the majority of the errors seem to be arising, that also allows NRR to start focusing its efforts on a more concentrated basis on, for example, specification, system requirement specification.

If it's an implementation error, I think we're getting pretty close to addressing all of that with the system development platforms. But design errors and things like that, if we can start portioning out and focusing our resources, the limited resources we have, in the areas that seem to have the biggest chance for failure, I think we'd --

MEMBER APOSTOLAKIS: So you agree with me?

MR. WATERMAN: -- do better to -- oh, absolutely.

MEMBER APOSTOLAKIS: Thank you very much. Steve has wanted to say something for a long time.

MR. GROBE: I was going to say --

MEMBER APOSTOLAKIS: Oh, okay.

MR. GROBE: -- we've now completed the first two bullets on the first of 10 slides in Paul and Mike's presentation. And unless it's critical, I think we need to move on.

MR. ARNDT: I just wanted to mention that -- to answer Sam's question, there was a small study done on the Korean plants, and that study indicated that at least in early implementation individual systems actually had a higher failure rate.

Now, some of that might have been familiarity and things like that, but that's the one data point which --

MEMBER ARMIJO: That's the sort of stuff I'm looking for. You know, what's the experience that's unique to digital I&C as compared to analog? And, you know, what are we doing about it?

MEMBER APOSTOLAKIS: There have been studies here and there. All I'm saying is somebody has to put everything together, and then say something about their applicability to nuclear facilities.

MR. ARNDT: Okay.

MR. LOESSER: Okay. We still maintain that high-quality design is the most important method to defend against common mode failure. However, even with that, it can occur.

MEMBER WALLIS: It seems like circular reasoning. I mean, high-quality design established doesn't lead to failures, and so the definition of "high-quality design" I don't think it adds anything.

MR. LOESSER: A problem we see is that no matter how high quality the design is, and no matter how much care is spent, there can still be subtle -- still be certain failure probabilities. We can reduce this with high quality, but we can't totally eliminate it. And the 1997 NAS study basically confirmed this.

MEMBER APOSTOLAKIS: Right.

MR. WATERMAN: Boy, this slide has gotten --

MEMBER WALLIS: There isn't a law that says that you have to have some residual failure probability, though. It's just that people aren't smart enough. Is that what it is?

MR. LOESSER: I think it's not so much people aren't smart enough, but the systems are so complex these days that no one person can understand everything in one of the modern digital systems. It's proportioned up and errors still occur.

MEMBER WALLIS: But it always works.

MR. LOESSER: That's what?

MR. GROBE: It must be an Apple product, not a --

(Laughter.)

MR. WATERMAN: The next slide is -- some time ago, over my years with the NRC, I've repeatedly heard from the industry that digital systems seem to be more reliable than systems they are replacing. And so it just occurred to me, well, when -- it's a relative term. What do they mean by "more reliable"?

So what I did was I got into -- this was my own initiative on the weekends, if you will. I dug into the archives of the operating experience report database and started doing some keyword searches on words such as computer and SPDS and things like that. The OER database is a database of reports that are required to be called into the NRC, 10 CFR 50.73-type reports on anything that would, among other things, prevent an operator from mitigating an event, for example.

In SPDS, obviously, if that doesn't work, they can't monitor their critical safety functions, and so they might impede their ability to mitigate a LOCA or some design basis event.

So I dug up some initial just counts.

There's 340 events shown on the slide here. There were a lot more hits than 340 -- I had to read all of those things -- and pretty much weeded it out to that. And I presented this at the Subcommittee, and there were some really excellent comments at the Subcommittee, and I've gotten some good comments from my management about, well, this doesn't really say a lot other than numbers, right?

And so I went back. Somebody had asked me, "Well, how many systems are installed? Can you normalize that data?" I did a rough normalization this morning. I don't know how many systems are in there, but I could make an estimate that back in '88 there were probably about 300 digital systems that were reportable.

If you look at safety parameter display systems, that's one in every plant. Right? So that's about a hundred. There's 65 plant sites, I think, or something like that. So you've got emergency response, sound the sirens, get everybody out of there. There's about 65 of those systems.

There's about 65 security systems that run the site, so you can have access to critical equipment and things like that. And so I figured, well, okay, about maybe 300 systems in '88. The industry has been continuously improving their systems trying to make them more and more safe, more and more reliable, and so looking back at '06 I figure there's probably now about maybe 600 systems, give or take, I don't know, that are reportable. Give or take, I don't know, 50 or 60, didn't really matter.

And what I wanted to see by doing that was, well, are things getting better? Are we learning from our mistakes, if you will? And what I found was that, yes, we are. Early on we got a lot of failures, as you see. Probably a lot of those are SPDS out there in 1989 and systems being newly installed. And as they mature, you know, the failures keep getting corrected, and they become more and more reliable.

And out in the year 2006, it looks like it's planing out to about, you know, one percent or maybe two percent of installed systems failures per year. So, you know, if you got 600, what does that mean? Well, you can read the graph there.

MR. GROBE: I want to make sure that the Committee doesn't interpret this as any sort of a risk analysis. This data is extremely raw.

MEMBER CORRADINI: That's okay. Raw data is very nice. I like raw data.

MR. GROBE: It hasn't been normalized by

any -- for example, the industry performance has improved dramatically over this period of time. So this was not LERs 50.73; it was 50.72 reports to the operating center. And the thresholds for those reports have changed during these two decades, so --

MR. WATERMAN: About 1998.

MR. GROBE: Yes, it's very difficult to use this data for anything meaningful.

MEMBER CORRADINI: Could you repeat your last thing that you said that -- in '98, what changed over? I'm sorry.

MR. GROBE: We revised and more risk-informed our reporting requirements in 50.72 and 50.73.

MEMBER CORRADINI: There might actually be more reporting after that point?

MR. GROBE: No, less.

MEMBER CORRADINI: Less reporting.

MR. GROBE: Less. So it's very difficult to use this data in an interpretive fashion. It's simply presented for the purpose of indicating that digital systems do have problems, you know, they're not perfect. I don't think any of us thought they were, but it's data.

MEMBER CORRADINI: Just so I understand

the Y-axis, it's number of events normalized or total number of events?

MR. WATERMAN: That's total number of events. And just this morning I wrote some little numbers in on my -- I didn't have time to update the slide, but --

MEMBER CORRADINI: So just let me say it back to you, so I understood what you were saying. that back in '88, when the SPDSs started up and other things started up, you were on the order of 300 or less, 200 to 300. And in '06, you were on the order of double that.

MR. WATERMAN: Yes, roughly double that. You know, my --

MEMBER CORRADINI: These are just raw numbers of observed events, given the trip points, just like an instrumentation system that you change your bandwidth as to what you report and what you don't report, blah, blah, blah.

MR. WATERMAN: That's right.

MEMBER CORRADINI: Okay.

MR. WATERMAN: Yes. In '98, I think they raised the threshold by saying, look, if something that could mitigate an event failed but its redundant component is still there, you can still mitigate the event. So why report it?

MR. BANERJEE: What are the yellow lines?

MR. WATERMAN: The yellow lines is the little history of our formulation of D3 policy and our SRP guidelines.

MR. GROBE: I think he's talking about the ones on the bottom.

MR. WATERMAN: Oh. The ones on the bottom -- the ones on the bottom, I just call out different years where different types of failures have occurred in systems such as in 1988. That was a reactor protection system failure that occurred at South Texas Unit 1. It was a software error in all four data processing system computers. That would have caused all four primary coolant loop calculated T-hots to fail, which would have defeated various tech spec required actuations.

MR. GROBE: It just gives you an indication of some of the more interesting events and what system they involve.

MR. BANERJEE: For that, yes.

MR. GROBE: And that's useful.

MR. WATERMAN: That's like a software failure. There's a -- let me see here. Turkey Point, that was a self-testing error in the software.

MR. GROBE: I don't think we need to go through all of them.

MR. WATERMAN: Okay. But anyway, what I really wanted to get a handle on with this data wasn't the numbers themselves but I wanted to confirm what myself is -- is diversity in defense in depth really such a big issue? I mean, are we just running around chasing our tails on this?

And it appears, just from the number of failures that continue to occur, that, yes, maybe we ought to be paying attention to that. So I just needed that reassurance myself to be a little bit more --

MEMBER APOSTOLAKIS: I think the real big issue is how much of that you need, not whether it's needed.

MR. GROBE: Exactly.

MR. WATERMAN: Yes.

MEMBER APOSTOLAKIS: What exactly you need. I don't think the industry is willing to take as much as we want, because last time they told us that they don't want to see any risk in any of this. Not NEI. Not NEI. NEI didn't say that.

MR. ARNDT: But the other point you indicated was that you wanted to see whether or not the sort of heuristic arguments that people were making, that digital systems are more reliable than analog systems, is true. And you can only do that if you have a similar plot --

MR. WATERMAN: Absolutely. That's absolutely true, and I'm just --

MEMBER APOSTOLAKIS: This is not really --

MR. WATERMAN: -- mine doesn't do that.

MEMBER APOSTOLAKIS: This is not accident conditions, Mike. This is not representative of what we are trying to do here, right?

MR. WATERMAN: That's right.

MEMBER APOSTOLAKIS: We're trying to put some diversity there to mitigate accidents, right?

MR. WATERMAN: Those systems are all systems that would be required to mitigate accidents, though, had an accident occurred. I mean, you do want the sirens to go off.

MEMBER APOSTOLAKIS: It's interesting.

MR. WATERMAN: It's interesting. You know, there's times when I wish that plot didn't exist.

MEMBER APOSTOLAKIS: Okay.

MR. WATERMAN: For my benefit.

MEMBER ARMIJO: It's amazing. I think

it's great. I think it's a great plot.

MR. LOESSER: To summarize our current policy, based on a SECY paper and an SRM, we asked licensees to assess the diversity and defense-in-depth, analyze each postulated common mode failure, to demonstrate adequate diversity. And that if a common mode failure could disable a safety function, then a diverse means is required to perform that or a different safety function to mitigate the same accident or transient.

And since common mode failures are beyond design basis, this can be a non-safety system if the safety is of sufficient quality. And we also asked for a set of independent and diverse displays and controls in the main control room to provide for manual system level actuation.

One of the questions that came up earlier -- these independent displays and controls could be non-safety, so there has to be a method of having these non-safety controls actually actuate a safety function. And this is one of the concerns about having a safety and non-safety mix at some point.

MEMBER APOSTOLAKIS: It's interesting. First, I hope that members notice the dates there -- safety from '93, the whole stuff is from '93. And then, all this discussion about failure modes is related to the second point there, postulated common mode failure. What do you postulate?

MR. WATERMAN: Okay. The next slide we're going to talk about task working group issues that we're going to be taking on.

MEMBER ABDEL-KHALIK: If we go back to the previous slide please --

MR. LOESSER: Yes.

MEMBER ABDEL-KHALIK: -- the third point, you sort of assert that common mode failures are beyond design basis events.

MR. LOESSER: Yes.

MEMBER ABDEL-KHALIK: Can you say that for additional systems at this time?

MR. LOESSER: That is the decision that was made by the Commission back in '93.

MEMBER ABDEL-KHALIK: But can you --

MR. LOESSER: Are you asking for a personal opinion or a staff policy?

(Laughter.)

MEMBER ABDEL-KHALIK: Given all the discussion that we're having regarding diversity and defense in depth for digital I&C systems, can you make that assertion as the starting point for the discussion?

MR. GROBE: The basis for the Commission decision, as I understand it at that time, was focused on what was perceived at the time as the probability of a common mode failure resulting in an accident. And there were some discussions that occurred, and it was perceived at that time that it was an extremely unlikely event. And my understanding is the Commission concluded, based on a variety of inputs, that this type of failure should be treated as beyond design basis.

MEMBER ABDEL-KHALIK: Thank you.

MEMBER MAYNARD: That's consistent with how we handle any other safety systems. Anyway, if you identify a common mode failure, that you're basically required to declare both systems inoperable and take whatever actions that are there by the tech specs. So the handling of this is the same as what --

MR. GROBE: I would suggest that this philosophy is equivalent to the way the Commission established policy in ATWS. It was a beyond design basis event, but something of substantive concern such that we have expectations in the area of ATWS. But it's not considered a design basis event.

MEMBER APOSTOLAKIS: So if --

MR. GROBE: The Commission was establishing a similar philosophical approach to this common mode failure of digital systems. If it's something of concern, we should have specific guidelines and expectations, but it's beyond design basis.

MEMBER APOSTOLAKIS: If they were considered design basis, what would you do?

MR. GROBE: How would it be handled differently?

MEMBER APOSTOLAKIS: Yes.

MR. GROBE: There would need to be safety-grade capability to accommodate common mode failures.

MR. LOESSER: The diverse system that we talk about in Section 3, 2.3, would have to be safety-grade as opposed to non-safety. And in addition, the analysis of the accident would have to be done on a worst-case timing basis as opposed to best estimate.

MEMBER APOSTOLAKIS: So you would have to consider the sequence where the digital I&C is part of it, and do the standard design basis regulation.

MR. LOESSER: Yes.

MEMBER POWERS: How difficult would it be to apply the single failure criteria to the systems to avoid common mode failure criteria? I mean, it would be very confused.

MEMBER APOSTOLAKIS: Yes. Common mode failure -- common cause failure is not a single failure.

MEMBER POWERS: But you would have to have single failure approved systems to prevent common mode -- or to accommodate common mode failure.

MEMBER MAYNARD: And it would be too trying for --

MEMBER POWERS: Really interesting.

MEMBER MAYNARD: You'd have to have two trains of a completely --

(Laughter.)

The fact that common mode failure isn't a design basis doesn't mean that we're -- that the industry is not required to mitigate for some of these, like that's what the ATWS is and stuff like that. So it doesn't mean that you're not required to mitigate.

MEMBER WALLIS: Do we know what "safety grade" means for digital systems?

MR. LOESSER: Yes.

MEMBER WALLIS: Ye?

MR. LOESSER: The safety grade requires that it be designed in accordance with Appendix B, they follow the requirements of 603 as required by 50.55(a)(h).

MEMBER WALLIS: All this applies to digital but not problem, right?

MR. LOESSER: There's always a problem. Any time you are required to do things to an exacting standard, it's more expensive and more difficult than going down and buying something at the local instrumentation shop. Yes, it's difficult, and it's expensive to meet the requirements of safety-grade equipment.

MEMBER WALLIS: This makes the digital system better because it's safety grade?

MR. LOESSER: We think it reduces the probability of failure, yes.

MEMBER WALLIS: Okay. Thank you.

MEMBER APOSTOLAKIS: But there is no real evidence of that. I think you're right, we do think that.

MEMBER WALLIS: Do you all have a safety-grade Mac like this, that's better than this Mac here in some way?

MEMBER APOSTOLAKIS: Under certain conditions it probably is.

MR. WATERMAN: Environmental qualification or -- I'd say it probably --

MEMBER WALLIS: But the digital plot itself is probably --

MR. LOESSER: Well, even there, if this was a safety-grade Mac, if you would, the operating system would have been carefully examined to look for flaws. The security applications thereof would have. Now, it --

MEMBER WALLIS: Do we know how to do that? Well --

MR. LOESSER: It would also impose --

MEMBER WALLIS: I'm a bit suspicious about whether you really know how to determine whether it's safety grade or not.

MEMBER APOSTOLAKIS: Can we move on?

MR. LOESSER: Yes.

MEMBER APOSTOLAKIS: So these are the kinds of things that you have to address. When will we see some preliminary thoughts on these things?

MR. GROBE: I expect the project plan would be finalized this month. That's my hope. And it will have specific dates, and we can set up periodic meetings with the Subcommittee to update you on the status.

MEMBER APOSTOLAKIS: You mentioned earlier that you have to take some action regarding the three D by the fall -- by fall?

MR. GROBE: That's the goal, yes.

MEMBER APOSTOLAKIS: So I would -- are you coming to us before you do that or after you do that?

MR. GROBE: Yes. You'll notice in the key milestones it includes consideration of going to the Committee to review generic requirements as well as the Advisory Committee on Reactor Safeguards.

MEMBER APOSTOLAKIS: Okay. So in three, four months we're going to see some answers to this.

MR. GROBE: Yes.

MEMBER APOSTOLAKIS: Good. Can we move on?

MR. WATERMAN: The working group scope -- as you can see right there -- is identify our existing requirements and how they're working. The research that I'm doing is to identify acceptable diversity strategies within the realm of diversity and defense in depth.

MEMBER APOSTOLAKIS: Would these strategies, Mike, be independent of the system you are looking at? Again --

MR. WATERMAN: Yes.

MEMBER APOSTOLAKIS: -- if I have a simple actuation system, and if I have a more complex system that controls the function, would these strategies be different?

MR. WATERMAN: I would expect strategies to be different, depending upon the system that you're designing for. And what the research is doing isn't trying to develop a strategy, but actually try to develop several different strategies. As you recall, in the Subcommittee meeting -- and it got lost out of this. I had that color wheel, if you will --

MEMBER APOSTOLAKIS: Yes.

MR. WATERMAN: -- of the six NUREG/CR-6303 diversity strategies and the diversity attributes and the criteria associated with that. And the objective of the research that's ongoing right now, and it has already come up with some preliminary results which we'll talk about here in a minute, was to try to identify, are there particular diversity strategies that have been used around the world that are shown to be kind of -- to be effective?

MEMBER WALLIS: I'd like to suggest this strategy is the wrong approach. The strategy is a means to an end, and you should define the end. End is performance-based. There are various ways to reach it. A strategy itself may look good on paper, but it may not work. So it's just a means to achieving something else, which is much more important.

MR. WATERMAN: Well, what shall I call it?

MR. GROBE: The complexity is -- that's what our current guidance does today. It defines the end state. The devil is always in the details, and what we're trying to do is to provide more descriptive --

MEMBER WALLIS: Just like saying I went through the right motions, but if you didn't get the right answer, then --

MEMBER APOSTOLAKIS: They mean more than that, though.

MR. GROBE: I think a better description is a more complete characterization of our expectations in the area of diversity.

MR. WATERMAN: Combinations of diversity attribute criteria that -- is what we're actually seeking, and it's not combinations that we invent ourselves, but it's -- what I'm trying to do is look at what's going on in other industries and in the nuclear industry, and what have other people found to be especially --

MEMBER WALLIS: As a measure of how well these work.

MR. WATERMAN: How well they work. And if we find some trends that, hey, look, everybody is using different microprocessors, that would be something we would recommend licensees do if they're going to build --

MEMBER APOSTOLAKIS: We don't have a lot of time, so --

MR. WATERMAN: Okay.

MEMBER APOSTOLAKIS: -- find a different word. But I think there are two things that are missing there -- again, the failure modes; and, second, we have asked the staff in the past to develop a classification of functions that digital I&C would participate in.

So, you know, actuation, control, and whatever else. And it seems to me those two items are needed everywhere and here as well. So before you move on to the -- to identify acceptable D3 measures, you really have to do that.

MR. GROBE: This really goes back to what Kimberly was describing as the two-step process. The research in the risk area is not going to be done in the next couple of months. And the question is: what approach do you take on diversity and defense in depth in light of the uncertainties and the lack of data in various areas? And that's what we're struggling with right now.

MEMBER APOSTOLAKIS: I know. I mean, if you have problems with the completeness and soundness of the approach, it doesn't seem to me that the step one would be very useful. That's my problem. I mean, it's one thing to know that you are doing something that's conservative, and quite another to have somebody say, "Well, I'm not sure it's conservative."

MR. GROBE: I understand. I understand.

MEMBER APOSTOLAKIS: So we have to really think about this part.

MEMBER ABDEL-KHALIK: The conceptual difficulty I have is that I have a report here by the National Academy that concludes that their appears to be no generally applicable effective way to evaluate diversity between two pieces of software performing the same function. And yet what you want to do here is define adequate diversity, which implies that you will quantify diversity, which is inconsistent with this statement.

So I just want sort of a clear response from you as to whether or not you agree with the National Academy report.

MR. GROBE: I don't know that we were

intending to quantify diversity. Let me just give one example and then I think maybe we can move on. I'm not a software engineer, I'm not a digital I&C expert, but this resonated with me.

And that is that if you're trying to define or you're trying to achieve diverse software, you would give the same problem to two different software design teams, where there's a central entity that is overseeing those design teams and insists that each team puts restrictions on how the team can solve the problem.

So you ensure that the two design teams utilize different techniques in developing the software to accomplish the goal. So you truly have two sets of software that were designed with what I'll call intellectual diversity. They solve the problem differently, and you have some controls in place to ensure that they solve the problem differently.

So in a sense, you have some diversity in the thinking that went into how to solve the problem. Those are the kinds of concepts that are being tossed about.

MEMBER KRESS: Said, we discussed this in the Subcommittee, and the thing I got out of it was that what they would do is develop attributes of what diversity meant. And these would be -- then, they'd have standards for these attributes. They wouldn't quantify them. They would use judgments as to whether the standards had been met for the various attributes. And, you know, that's about as far as you can when you can't really quantify it.

MEMBER CORRADINI: So if I could just ask -- so just to reflect on that, so what you're saying is the diversity will be defined based on attributes of development and process of development, not on testing of the software.

MR. WATERMAN: Well, testing is one approach where you can have different testers and different test programs, for example. That's one of the attribute criteria in --

MEMBER CORRADINI: But that wouldn't prove diversity or lack of -- that would just prove it works by a certain test.

MR. WATERMAN: Yes. By difficult test. For example, submit it to fault injection testing.

MR. GROBE: Why don't we go on to Slide 17. And it gives a broader perspective on diversity, and maybe we can help --

MR. WATERMAN: But I'd like to iterate that what Dr. Apostolakis says is very important. If you don't know where the failures are, then how do you know that the diversity approaches or strategies, whatever you want -- how do you know that those strategies are really the appropriate strategies?

If you have a lot of failures in specifications, then it would seem that one of your diversity attributes ought to be specification, diverse specifications.

MR. GROBE: Mike, you've got two minutes to cover the next three slides.

MR. WATERMAN: We have ongoing research right now that is being conducted by Oak Ridge National Lab to try to answer the question: how much diversity is enough? And we've gotten some preliminary results out of that.

Now, we have six diversity attributes identified in NUREG/CR-6303, which was written by Gary Prekshaw out of Lawrence Livermore National Lab back in the mid-'90s. And those attributes are design, equipment, function, the human diversity, which I call life cycle process diversity if you will, system diversity, and signal diversity and software diversity are the six attributes.

What we did is we went out first to different agencies and different industries and asked them, "What are you doing about diversity?" And we looked at NASA, who obviously are in control of the space shuttle, the International Space Station, their contribution to it. We looked at the Johnson Space Flight Center, Mission Control there.

We went to FAA and said, "What are you doing about flight control systems in your tower?" Things like that, tower control systems. "What are you doing for diversity?" Looked at some airline -- airplane manufacturers, airbus, the A-320, took a look at what they're doing for diversity in our flight control/avionics systems.

We also took a look at the Boeing 777 to see what they are doing for diversity in their avionics system. Then, we took a look at DoD, and, first, we thought, well, let's take a look at what they're doing in the subs. They've got nuclear reactors, right? Well, most of that stuff is classified, so we sort of had to abandon that approach, because we wouldn't be able to publish the results. But we take a look at DoD battlefield management, if you will, how do you integrate a battlefield.

Now, we also took a look at electrical grids -- you know, how do you manage electrical grids, so that it doesn't go down, you know, on a software error? And then, we also look a look at the chemical industry, petrochemical industry.

And the green shaded boxes here are the types of diversity that are applied for these various systems here. Now, over in that right column you'll notice those little hash marks, slash things there. What that represents is all of those different types of diversity are used in the chemical industry. It's just not universally accepted in the chemical industry.

One company may use equipment diversity. Another company may use software diversity. So it's -- so there's no way to pin it down to "the chemical industry does this."

MR. GROBE: The message the Committee should receive from this -- I want to make sure that there's no inference that one green box going horizontally across the page is interpreted as equivalent to the next one. It just means that the space shuttle and the space station both have attributes of functional diversity. They may be completely different attributes that are considered.

The other message that you should get from this is there is no standard on this whatsoever across any industry.

MR. WATERMAN: The next step on those results is to tunnel down into, for example, design diversity on the FAA flight controls internally and find out, well, okay, you're using design diversity. What kind of design diversity are you using? And find out, are they using design diversity that involves one attribute or another criteria?

MR. GROBE: Let's move on.

MR. WATERMAN: Moving on to the next, we also took a look at primarily the European nuclear reactors and tried to determine, what are they doing about digital system diversity in their plants? And we came out with some preliminary results on that.

For example, looking at Sizewell, and you can see -- now, the slashes in this plot are a little bit different than the slashes in the last one. The slashes in this plot for Dukovany, Beznau, and Paks are -- as you recall, the European plants use graded safety systems graded A, B, and C.

We have graded here in the United States, too -- safety grade or it's not safety grade. but in the European plants, it's safety grade A, safety grade B, and safety grade C. Now, all the green shading you see there are safety grade A systems. The --

MR. GROBE: Which is equivalent to our safety-related.

MR. WATERMAN: The more lightly shaded boxes are credit for safety grade B, and which provides some diversity there, because the safety grade B may be using different equipment, for example. So that is --

MEMBER APOSTOLAKIS: Maybe we can discuss the possible approaches, Mike, and -- you know, and --I'm sure you will come back with the same stuff in a different context in the future. So let's --

MR. WATERMAN: We're looking forward to that.

MEMBER APOSTOLAKIS: All right.

MR. LOESSER: On possible approaches for addressing D3, we've looked at this and some of the initial thoughts here -- not initial, we've been thinking about for a long time, is that, first of all, diversity and defense in depth requirements should be the same for new plants and for current operating plants.

Second of all, that there should be sufficient diversity to mitigate adverse effects of protection system malfunctions in the presence of a single failure and all non-detectable software failures. That for safety functions that do not incorporate within themselves adequate diversity to prevent a common cause failure, common mode failure, provide diverse automated backup safety system functions.

And fourth is the same as the existing one -- provide displays and controls in the main control room for manual actuation of the safety equipment to manage the plant's critical safety functions.

MR. BANERJEE: What does the third bullet mean exactly? Not incorporate sufficient --

MR. LOESSER: There are some designs that have inherently within them a certain degree of diversity. An example was the B&W Star system that had two separate processors on each board. There have been some other proposal systems, and certainly they could be deliberately designed, such that diversity is built into the one system. And if that's the case we wouldn't --

MR. BANERJEE: And common mode failure would knock both of them out?

MR. LOESSER: Yes, that's correct. And if that is actually true, and a system like this is proposed, then they wouldn't need a diverse system because the issue we're worried about -- common mode failure -- is already taken care of.

MR. BANERJEE: That means that these two systems would be -- have to be sufficiently diverse in some way.

MR. LOESSER: That's correct. And that would have to be -- that's part of what Mike's research is on what is sufficiently diverse. That was the previous two slides. What do other countries do for diversity?

MR. BANERJEE: Well, I noticed you didn't put Canada, which uses two completely different shutoff systems, clearly diverse.

MR. WATERMAN: Excuse me. This is Mike Waterman. Yes, we looked at Darlington --

MR. BANERJEE: Right.

MR. WATERMAN: -- SDS, shutdown system 1 and shutdown system 2. It didn't show up on this plot, but we have looked at that. I believe they used formal methods on that to verify that they were sufficiently --

MR. BANERJEE: They don't have computer -- digital I&C. It's still --

MR. WATERMAN: Yes. No, I think it's digital in shutdown system 1 and 2. They use formal methods to validate the -- that they were correct.

MEMBER APOSTOLAKIS: They use the formal methods, you're right. A variation of formal methods, but also a lot of testing under different conditions. Yes, it was really a very nice piece of work.

MR. WATERMAN: Yes. It was one heck of a project, to tell you the truth. I was somewhat involved on the outside watching.

MR. GROBE: I want to emphasize on this slide that this is not a staff recommendation. These are just some things that we're thinking about. And this is -- not contrary, but different than the current Commission policy.

MR. WATERMAN: But keeping in mind on that first bullet, the Commission policy, when it was written, made the assumption that current operating plants, they had their main control board laid out there. It was all analog. They had a diverse system already. Go ahead and put in a digital system. You've still got your analog backup.

Well, then, plants decided, well, we've go to replace that stuff, too, it's getting old. So that changed the whole game. Now you have a plant come in, says, "Well, we need new RPS, we need new ESFAS, and we're going to change out all of our main control boards and make that digital, too." Well, gee, that's just like a brand-new plant, right?

And so, then, the diversity issue that we're applying the diversity -- the requirements that we're applying to new plants probably ought to be applied to existing plants, too, because, I mean, what's the difference. And that wasn't captured in the original SECY position.

We're trying to just bring that out now that, hey, if a plant is going to get its whole plant, they probably ought to consider putting in a diverse actuation system, if they don't have enough to --

MEMBER APOSTOLAKIS: Okay. We have 18 minutes.

MR. GROBE: Yes. Steve Arndt is up to the challenge.

MEMBER APOSTOLAKIS: You guys are too slow.

MR. ARNDT: I'm going to talk to you a little bit about the issues associated with risk-informing digital instrumentation control licensing, which are very significant. And I'm going to go through the first three or four slides very quickly, on basically background and status.

I want to emphasize before I go forward, the three things that George mentioned earlier in the presentation -- understanding operational experience, understanding lessons learned on what we have tried to do, and categorization of the digital systems -- are all part of this work. Could we do more? Could we do it better? Certainly. And I'll bring those in as they come.

We've been looking at this for a number of years. The basic issue is our current regulatory position is entirely deterministic. We've actually looked at trying to risk-inform it in the past and said we're not ready yet. We look at the process, we look at testing, design, and based on that make a determination of adequate protection.

The PRA policy statement encourages the staff to look at risk-informing, to the extent supported by the state of the art. And, of course, one of the big issues is: what is the state of the art, and what does the state of the art need to be for us to take the step to risk-inform?

As I said, currently, we don't use risk-informing type methods in our reviews of I&C. There has been a very small amount of risk insight type discussions, but none of that has been formally included in any of the license submittal reviews.

MEMBER WALLIS: That means you have no

measure of the likelihood of failure.

MR. ARNDT: No. It means we're not using it as a --

MEMBER WALLIS: But deterministic doesn't give you any measure of the likelihood of failure, so what is it -- you have no idea of the probability of failure. Is that correct?

MR. ARNDT: We do not use it as an integral part of our licensing decision.

MEMBER WALLIS: If I asked you what it was, you couldn't tell me what the probability of failure was.

MR. ARNDT: No. I could tell you what the probability was, but I wouldn't include it in my regulatory decision.

MEMBER WALLIS: All right. So you do have a way to calculate it.

MR. ARNDT: I have ways of estimating it. The issue is: am I certain enough of that mechanism to use it in a regulatory decisionmaking process? And that's the big issue.

For new reactor reviews, particularly the design certs, we've looked at how plants have incorporated digital systems and common mode failure software and other issues into the design cert PRAs that have been presented so far. These are relatively high level. As you know, digital I&C and human machine interfaces in the current design certs are very general. Most of that has been pushed to the DACCS.

What they've done is they've looked at -- used standard fault tree/event tree methods, varying levels as low as circuit board level, hardware data derived from some generic or proprietary databases, and some uncertainty analysis and important studies to give a general feel for what the issues were.

Our reviews of those have reemphasized the importance of diversity in these systems to mitigate some of these uncertainties, both in terms of methods in data as well as what's actually being put out there.

There is a myriad of modeling challenges associated with doing this. I won't go through all of them in detail. This has been discussed in the literature and in heated debates in conferences and meetings for the last 10 years. Software reliability is, of course, a very big issue, common mode failure is a big issue, the failure data is an issue, time dependencies and how important they are.

One of the big issues that we're just now really starting to get a handle on these systems -- a lot of them -- the significant fraction, if not the majority of the software and the hardware, is fault detection, diagnostics, things like that.

Well, that's wonderful, because it will stop failures from propagating, but could also cause failures. And there's several examples at Turkey Point. Load sequencer is an example where because the system was in diagnostics and didn't trip back into the regular mode when it got a demand signal, it had a failure. So there's black and white associated with this. And how do you model that and have confidence that your model is reasonable is a big challenge.

In developing this, there is also some, how do you deal within the regulatory space? The acceptance criteria and the PRA quality standards are fairly general and don't talk to these issues specifically. And we don't know exactly whether or not we want to add additional guidance on that or not.

Another thing --

MR. BANERJEE: Is there any sort of requirement to also give guidance on how these things should be tested? I mean, modeling is one aspect.

MR. ARNDT: Yes.

MR. BANERJEE: But testing is another.

MR. ARNDT: From a deterministic standpoint, if you look at the requirements in 603 and the branch technical positions and things like that, we basically have a life-cycle process that you have to do, which include testing, both testing as you develop it, testing as you integrate it, and independent verification and validation afterwards, both in terms of paper reviews and testing reviews.

MR. BANERJEE: But these would be specified in terms of some sort of range of parameters which go outside the normal. I mean --

MR. ARNDT: If you start looking at operational reliability, which of course this effort is looking at, yes, you're exactly correct. How you convince yourself that you understand what the operational profile, which is the -- in software speak, that you understand it properly, and you understand what may or may not happen if you go outside the expected things.

There's a couple of ways of dealing with that, the most powerful of which is to go out and specifically test it. And I'll talk about that in two or three slides. That's one of the ways we're looking at developing reliability models based on actually physically testing it outside its bounds. There are other ways -- analytical ways of doing that, including formal methods and other things.

MR. BANERJEE: Well, the reason I'm asking this, I'm involved in some -- ranking some very large software packages for completely different reasons. But the way that gets tested -- part of it is you just distribute it to a whole lot of people, and they'll think up incredibly diverse ways to bring it down, you know, this beta testing phase. None that you've ever dreamed of, by the way.

And eventually it -- the system becomes robust over a period of years, as this experience gets fed back and things get -- so if you sit and try to define how you're going to test it, most of the time you won't think of all the ways it can go wrong.

MR. ARNDT: Yes. And there's -- there are modeling methods that look at how you test it and what you test and how it gets better over test, or worse, which can happen. And that's one of the big issues associated with software reliability modeling.

MR. WATERMAN: And one of the things you do when -- one of the things that is done on a high-quality system is, as the requirements are being developed, the requirements are weighted against, can you test that requirement after the system is built to ensure that the requirement has been met?

Now, that's one of the things I look for when I review a digital system and development effort is: are the test plans being developed in concert with the requirements, or are they being developed after the design has been done? If they are being developed after the design has been done, there's always that question of, well, did you really test everything?

And so that's one of the things that should be done on a high-quality system is every requirement must be assessed from the standpoint of what is the acceptance of that requirement? How do I test that requirement to be sure that it is met?

MR. BANERJEE: It is relatively standardized. Experience just starts to feed back over a period of time. If each system is different now, it's going to be a hell of a job.

MR. ARNDT: And so far each system has been different.

MR. BANERJEE: Yes.

MEMBER CORRADINI: So I guess -- I know you want to get to the end, but I just had a question to follow up Sanjoy's. So in this area of software testing, I guess the place -- I'm just wondering, has the staff thought about going to a place where I would check with software testing first? Have you gone to an expert at Microsoft and at Apple in terms of -- some of their things actually do work. Some of their things actually do work.

But in terms of how they do internal testing, similar to what Sanjoy is saying in terms of beta testing --

MR. WATERMAN: Well, we have done some of our own research with the University of Virginia on the fault injection type of testing. That was done by Dr. Barry Johnson, and we're still interacting with them on the development of that process. And he has had some fairly good success using fault injection testing methodology.

MEMBER CORRADINI: Okay.

MR. WATERMAN: But the suggestion to go out to industry I think is an excellent suggestion.

MEMBER CORRADINI: I mean, unless it somehow is proprietary in how they do the testing, it seems to me that that would be a useful way to go after what Sanjoy is talking about in terms of beta testing, because that's what is done in industry.

MR. WATERMAN: I think we should also be looking to the Department of Defense and the FAA who do mission-critical type software development. There is some -- you would almost call it mission-critical applications that Microsoft develops, but if you talk to somebody who is actually developing a trigger device for a nuclear weapon, that's high-quality software. And how they go about testing may be something that we could apply to the nuclear industry, too.

MR. GROBE: Okay. Let's move on.

MR. ARNDT: Okay. In terms of both the short-term and long-term strategy, let me take just a couple of seconds here. The industry has some issues, and the NRC has some issues, and, of course, the general community has some issues in the whole area. In developing the task working group in this area, we focused in on two short-term and one longer term issue.

The two short-term issues are based on regulatory decisions we want to make right now. One is to better clarify what is required in terms of the Part 52 PRA in digital system modeling, both the design certs that we haven't processed yet, and, more importantly, in the COL applications.

The second issue is: can we use some information like Professor Wallis and I were debating at the beginning of this, to help us use the risk insights in current operational reactor reviews? How do we do that, and how far are we comfortable using those reviews? In both these areas, the industry is going to provide us their thoughts in terms of white papers, based on experience, and what they think the state of the art is, and what they think we can do.

We're going to look at our internal processes. We haven't done a lot of this stuff, but we have looked at it a little bit. We're going to look at the research output to date, which I'll talk about very briefly in a second here, and also take all that put together and write some interim guidance on these two issues. These are actual regulatory decisions we want to make today with as much information as we think we have.

In the longer term, we want to develop a comprehensive risk-informed decisionmaking strategy equivalent to the 1.174 process, which would allow us to do robust analysis for a number of different regulatory decisions. This is a higher threshold, so we want to have a much better understanding.

So in that longer term, we're going to look at, what are the current capabilities, and what are the advantages of going to more advanced techniques? We're going to look at the best practices.

As Professor Apostolakis mentioned earlier, we've gone to NASA and to the transportation industry and to the French and to the Finns and to the Germans and other people and looked at what they're doing.

We also want to test these things in a specific benchmark-type study, and we have two systems that are -- have different characteristics -- again, going to George's comment on you want to understand the characteristics of the system. One is an RPS and one is a feedwater control system, and then, based on all of this information, develop some long-term regulatory guidance.

So again, very quickly, we're looking at both the capabilities of current traditional modeling methods and the advantages of advanced methodologies. We're in the process now of reviewing and developing acceptance criteria for the attributes of a traditional modeling method. As part of that, we looked at the AP1000 PRA. We're currently looking at the ESBWR, vendor PRA, we've looked at PRA that was done on the ESFAS system for a Korean plant.

We're going to peer review this. We're

going to bring it to the Committee to look at and develop that. In the dynamic area, for various reasons we're a little bit further ahead on that, and we've already published one report on best practices and made some recommendations on possible ways of doing this.

We decided, based on that review, that the two methods that are most powerful and most practical are dynamic flow graph methodologies and Markov modeling, integrated into a traditional PRA using a mapping technique. If you're interested, I'll point you at a lot of papers on the theory associated with that.

What we found is that although this presents a lot of technical challenges right now, it is feasible. Now, the real issue is: can we make that more practical? And as George mentioned earlier, is it necessary for all the different systems? The big issue here is: what is the actual requirement based on the attributes of the systems?

You want to be able to model it to the point where you capture all of the unique aspects of the digital systems.

Some of the issues that we have that need to get resolved if we're going to use the traditional modeling methods, as the industry would like us to do, is dealing with understanding the failure modes and how to model those failure modes, both in terms of the level of detail to capture them, in terms of the potential failure modes, the propagation of failures, which is a very difficult thing to model, particularly because of its timing issues, as well as its modeling issues, because that's not something you traditionally model in a beta factor. You can, but it's not an easy thing to do.

You also have issues with parameter data and, of course, the big elephant in the room, the software reliability models.

So where do you --

MEMBER WALLIS: I'm a little puzzled. I know you've got no time, but I think you have to be able to model these failure modes, and so on.

MR. ARNDT: Absolutely.

MEMBER WALLIS: You're doing the right thing. What I'm worrying about is how all of the other people can make their decisions without understanding the failure modes.

MR. GROBE: And that gets back to the level of diversity --

MEMBER WALLIS: Yes, but that's just talk.

I mean, if you understand the failure modes, you're just talking about it.

MR. GROBE: Right.

MEMBER APOSTOLAKIS: It's really important, Jack. It has to be done as soon as possible. It doesn't have to be perfect, but it really is a major input to this.

MR. ARNDT: Okay. The issue -- where we are right now, and where we think we're going. The two short-term intermediate guidance tasks -- we're going to use what we know and try and get the best situation we can for the decisions we have to make today. Those are going to be done six months, a year, and we're currently working out the details with NEI and other stakeholders.

In the longer term, I'll go back and reiterate the four points to put a point on it. It may be possible to use traditional modeling methods if we can overcome some of the limitations, and the industry has some ideas that they are providing to us as well. The dynamic methods, the advanced methods, are capable of modeling the unique aspects, but they are challenging to implement. But we think, at least in principle, that that's possible.

The two other issues are, as we move

forward on this, we don't want to make this PRA technology-specific. We want to make -- develop the attributes of a model that would be acceptable, things like you have to be able to understand cross-communications, you have to be able to model the kinds of failures we've seen, and things like that, which may drive you to a particular technology or not, or modeling methodology or testing methodology.

One of the nice things about the dynamic methodology that I didn't talk about is that we're not modeling hardware and software separately. We're doing a states-based model of the system. It doesn't matter whether bit flips in the memory or there was a wrong line in the code. If you go from one state to another, you get there.

And the last part is developing a mechanism to categorize the digital systems to help us assign attributes to required systems. And we're very preliminary at this point. We're looking at the systems importance and systems complexity, and how much interaction it has with the system and the kind of decisions the system is going to be required to make as ways to build up a categorization scheme. But that's still very preliminary and we're not ready to present that.

MR. BANERJEE: So are the main failure modes of interest mainly to do with the software part of this, or are you also concerned about --

MR. ARNDT: Not necessarily. I mean, that's one of the unique aspects. But there is --

MR. BANERJEE: The rest of the stuff you know, right, or not?

MR. ARNDT: The issue here is complexity. That's the biggest problem. Software makes it easy to make it complicated. You can make software very simple, but most people don't for a lot of different reasons. But there is also issues like interactions between the hardware and the software, the issue of -- you can do a lot more in complex communications with a digital system than you can in --

MR. BANERJEE: In very simple-minded terms, the software can fail by itself? It can fail in interactions with the hardware, and then the hardware can fail by itself, I mean, in rough terms.

MR. ARNDT: In very rough terms, although I'd be a little uncomfortable with that.

MEMBER APOSTOLAKIS: Don't forget the human.

MR. BANERJEE: But the hardware failure you already handle.

MR. ARNDT: We have a much better understanding.

MR. BANERJEE: Right. What is of more concern, the interactions between the software and the hardware or the software itself?

MEMBER APOSTOLAKIS: No. The first one, I think, right?

MR. ARNDT: That is probably the most difficult to understand and to characterize. There has been a lot more research and a lot more practical issues associated with non-real-time software, simply because there is so much more of it out there.

MR. BANERJEE: So you are saying the problem is not QAing the software and making sure it does everything right. It's the interactions with the hardware.

MR. ARNDT: It is a problem, but it is not as challenging.

MEMBER APOSTOLAKIS: And it has been handled already where --

MR. ARNDT: There's a lot more information out there.

MEMBER WALLIS: Well, there are also accidents occurring to the software itself, like surge and things, which have --

MEMBER APOSTOLAKIS: This morning I was trying to type up something and it froze on me. It was -- nothing to do with me. It has nothing to do with me.

MR. BANERJEE: How would you do it with --

MEMBER APOSTOLAKIS: Can we wrap this up now?

MR. ARNDT: Yes, sir.

MEMBER APOSTOLAKIS: I think you're done, aren't you?

MR. ARNDT: Yes, we're done.

MEMBER APOSTOLAKIS: Any questions from the Committee of an urgent nature?

MEMBER MAYNARD: I just want to -- in the Subcommittee meeting they had presented some schedules and upcoming things. I just wanted to make sure those haven't really changed. You didn't present any schedules today, but --

MEMBER APOSTOLAKIS: But Jack told us that they have in this document that was handled us -- there are some schedules there. But they will be refined, is that what you said?

MR. GROBE: One of the focuses of the task working group's meetings this month are to ensure that the schedules are aligned with the industry's and the staff's needs. Some of those schedules may stretch out; some of them may come in. And we hope to have that done this month.

MEMBER MAYNARD: But I had offered a compliment for having some schedules and things laid out. I just wanted to make sure that hadn't gone away.

MR. GROBE: No. No, no. It's just being refined.

MEMBER MAYNARD: Okay.

MEMBER APOSTOLAKIS: Okay. Now, well, thank you very much.

MR. GROBE: I'd just ask Mr. Hammer to work with the staff and identify some appropriate times for us to come back to the Subcommittee.

MEMBER APOSTOLAKIS: Wonderful. Yes, thank you. Okay. Great.

MR. STONE: Will we be able to make a comment, or are we going to get a --

MEMBER APOSTOLAKIS: I'm sorry?

MR. STONE: Will we be able to make a comment as far as the industry?

MEMBER APOSTOLAKIS: Go ahead.

MR. STONE: I just wanted to make a comment that --

MEMBER APOSTOLAKIS: Who are you, please?

MR. STONE: I'm Jeff Stone from Constellation.

MEMBER APOSTOLAKIS: Would you identify yourself?

MR. STONE: Jeff Stone, Constellation.

MEMBER APOSTOLAKIS: I'm sorry. Okay.

MR. STONE: We characterized the challenges to traditional methods on his recent slide there. Almost all of those challenges also applied to dynamic methods, except for some of the communications issues. I wanted to make that clear -- is that we don't have data. The data is still a problem right now with the dynamic methods. It's still a problem as far as the software quantification, which may be dominating failure. Well, I can't say that for sure.

And the level of detail -- you also have to do a failure modes and effects analysis, whether you're going to do a dynamic test or modeling or whether you're going to do a traditional method. I just wanted to make that clear.

MR. GROBE: It may be appropriate to point out that the industry and the staff are not aligned, primarily from a cost-benefit perspective, on the importance of dynamic modeling to our future understanding of how to deal with risk in digital systems.

The industry believes that dynamic modeling is not as viable a success path as the staff believes, and that's one of the issues they're going to sort out this month, hopefully.

MEMBER APOSTOLAKIS: And that's where we need, again, the classification of functions. For some functions it may be appropriate, but for others it may not be. We really need those things.

Any other comments? We are scheduled -- well, we don't need that. Thank you very much.

We are scheduled to have a discussion until 10:30. But then, in the afternoon, we are going to have another discussion where you will advise me regarding the letter. Do you want to do that now, or just have a general discussion now, and then in the afternoon we will become more specific? What do you think?

CHAIRMAN SHACK: Let's do it that way. I mean, give people a little time to think --

MEMBER APOSTOLAKIS: Yes.

CHAIRMAN SHACK: -- have the afternoon.

MEMBER APOSTOLAKIS: So we'll spend 10 minutes now. If anyone wants to say anything --

impressions.

MR. BANERJEE: I do.

MEMBER APOSTOLAKIS: Okay, Sanjoy.

MR. BANERJEE: All this seems very high level to me. You know, it's not -- I'm used to more practical things coming out, and I'd like to see some concrete examples. Otherwise, I -- this is just sort of words, you know. I didn't come away from this really understanding what the problems were. It's as simple as that.

MEMBER CORRADINI: I guess if you're looking just for straight comments, I think the thing that I -- maybe it was Sam that said it first, but I guess I would agree with it -- is that we really need to get some sort of industrial experience that are non-nuclear or other country industrial experience on nuclear side, in terms of how the digital I&C performance is in comparison to analog systems.

I guess I'm -- this is not my area, and I almost -- you've almost convinced me I don't want to learn any more about it someway. But I really do think if you're going to get specific about it, you'd have to compare a certain class of functions and look at what the digital system does in relation to the analog system and industrial performance.

Otherwise, I don't -- you kept on mentioning the need for failure modes in digital I&C, but it seems that's the way you're going to get it relative to real hard-nosed experience.

MEMBER APOSTOLAKIS: That's right.

MEMBER CORRADINI: And to me, that's the most important thing, that --

MEMBER APOSTOLAKIS: For me, too.

MR. KEMPER: If I could -- this is Bill Kemper. This is Bill Kemper.

MEMBER APOSTOLAKIS: Since the days of the National Academy Committee, there have been debates regarding the applicability of this and that and that. And the reason has been, and still is, that there isn't a single document that says this class of digital stuff on reactors simply actuates a system. This controls it. This does something else.

There are different levels of complexity. So you are hitting people with a dynamic part that the Subcommittee reviewed last time, and Steve alluded to today, and they get scared. Who is going to do that? Where is the data? Am I going to do this for the reactor protection system? This is essential to identify for which functions certain modeling needs are required -- are present. And we haven't seen those tests.

And to say that software malfunctions and all that, it has to become more specific. You are absolutely right. You have to look at what happened.

MR. BANERJEE: You have to have a logical debate on how many angels can dance on the head of a pin.

MEMBER APOSTOLAKIS: Or can be --

MR. BANERJEE: Until you get concrete about -- and say this system, this system, this system.

MEMBER APOSTOLAKIS: Right.

MR. BANERJEE: You know, this is --

MEMBER APOSTOLAKIS: Yes, we'll come back to this. Any other --

MR. KEMPER: Yes. Could I make a comment, please, if there's time?

MEMBER APOSTOLAKIS: Yes.

MR. KEMPER: Yes. Bill Kemper from the Office of Research. I just wanted to make one comment on the idea of making a direct comparison between analog and digital safety systems and digital -- excuse me, protection systems and digital protection systems.

Analog systems -- the way they're

designed, primarily the failures are discrete failures, so generally you don't have in the analog world a wholesale reactor protection system failure as a result of discrete electronics failures. Whereas, in the digital world, those systems now are software-based. So one common mode failure that takes out the software system for a reactor protection system will, in fact, disable the entire system with one failure.

So it's very difficult to make a one-to-one analysis, if you will, or comparison of analog-digital protection, or safety system versus digital safety systems

MEMBER KRESS: I agree, and I don't really see the utility of making that comparison, frankly. I don't know what you would do with the results. You're going to go -- it's inevitable you're going to go to digital I&C, and I just don't see the --

MEMBER APOSTOLAKIS: Yes, it's not a matter of selecting.

MEMBER ARMIJO: No, no, it's electric. You know, what you're -- what's the unique problem that you have to --

MEMBER KRESS: But it doesn't seem to me -- it doesn't seem to me like you get that out of a comparison.

MEMBER POWERS: And we've been doing that for -- what the unique problems -- I mean, Bill said it.

MEMBER KRESS: That is the -- what else do you need to do? What was my point.

MEMBER POWERS: Yes. I mean, how often do we have to have that lesson? I mean, I -- for 10 years I've heard that lesson now.

MEMBER KRESS: So --

MEMBER POWERS: I've got the message.

MEMBER KRESS: So there seems to be a disagreement among the Committee on that part of it, but I certainly agree with you on the need to determine the failure modes and identify them.

MEMBER APOSTOLAKIS: I have read a number of them over the years, you know, what happened in that area. You always learn something. I mean, it's really knew. It's a -- and maybe this afternoon I can speak one or two to --

MEMBER POWERS: We spent an enormous amount of time looking at the Virginia class digital systems, and they seemed to have come up with a solution.

MEMBER APOSTOLAKIS: Who did?

MEMBER KRESS: The Virginia class.

MEMBER APOSTOLAKIS: Us?

MEMBER KRESS: Yes. We looked at that as a Committee. We can't discuss it right now, but --

MEMBER POWERS: No. But, I mean, they did seem to come up with a solution, and --

MEMBER KRESS: That's what I thought.

MEMBER POWERS: -- and so why can't some perversion of that solution be pursued?

MEMBER APOSTOLAKIS: Did you say that you are talking to the Navy, or you cannot talk to the Navy?

MR. WATERMAN: We are not talking to the Navy, because we really can't use the results. Most of that stuff is classified.

MR. KEMPER: This is Bill Kemper. I have been down to Naval Reactors. I have reviewed the -- what is it, the Los Angeles class I think, submarine -- the safety analysis report myself. And, of course, we can't say anything specifically, because that's all classified information. But we're well aware of their design criteria, and they -- and they do have a robust system.

MEMBER POWERS: The Los Angeles class is not nearly as good as the Virginia class.

MR. KEMPER: Maybe that was Virginia. I'm sorry. I'm not sure. It is the latest one, anyway, that we reviewed.

MEMBER POWERS: That was the Virginia class probably.

MS. KEITHLINE: This is Kimberly Keithline. I spoke with some representatives from Naval Reactors last month, and they indicated that if there were areas where we thought what they've done could be helpful to the commercial industry that I could go and talk to them about what they'd be able to share.

Now, it may be very difficult because of the classification. But if this is an area where additional conversations may be helpful, there is an open invitation. I'm just not sure --

MEMBER APOSTOLAKIS: I understand this issue of classification. If there is a method for handling the thing, the method is classified?

MR. KEMPER: The design is --

MEMBER APOSTOLAKIS: Steal it and present it as your own.

(Laughter.)

MR. KEMPER: But then they would have to put her in jail if she did that. The design itself is classified.

MEMBER POWERS: But the approach -- I doubt that the approach is classified.

MEMBER APOSTOLAKIS: Yes, I doubt it, too.

MS. KEITHLINE: I would need to discuss that with -- to see what they'd be willing -- I'm in a little bit of an awkward position because I know what they do. But when I left I -- I can't just come and discuss it, but I'll go talk to them about what we can discuss, if anything.

MEMBER APOSTOLAKIS: Please.

MR. CROTEAU: Let me just add one more thing. This is Rick Croteau. I'm in Research, and I have been down there also. And I think, quite frankly, we would be happy if the industry was willing to do what the Navy would do, but I don't think they're going to go there. All right? So I'll leave that at that.

MEMBER POWERS: Well, we can always tell the industry that -- do it this way, or do it the old way. I mean --

MEMBER MAYNARD: Well, I believe -- first of all, I think there are some good things going on. I think that the Committee -- they do have some milestones they did present to the Subcommittee, and they are driving some things forward.

My concern is this has been going on for some time. If we don't come to some conclusions soon -- and I don't think we're ever going to have all the answers, not going to ever feel 100 percent confident, we're never going to get to a point where there is zero risk.

I think at some point we're going to have to say this is the information that we have and these are the decisions we are going to make, provide the guidance, because if we don't it's going to be done by default, because things are moving forward. And we'll come out with the guidance after the designs are already done, which is probably not the best way to --

MEMBER POWERS: Right now, the basic design is go ahead and put your digital reactor protection system, put an analog backup.

MEMBER MAYNARD: And I believe that, depending on what we talk about for analog backup -- I believe that there is a need for a diverse way to shut the reactor down and do some things. I don't believe that there is a need to have a complete redundant safety-grade analog backup system to do that. In fact, I believe that adds complexity and can actually degrade safety overall as opposed to some other methods that are out there.

But in any event, at some point decisions need to be made and need to move forward. If we make it too complicated, if we try to say, "Well, we're just going to be overly -- we'll take the most conservative position," that may not be the most conservative position. That may be detrimental to safety as opposed to being in favor of it.

MEMBER APOSTOLAKIS: So I would like to stop here and continue in the afternoon.

MEMBER ABDEL-KHALIK: I would like to just reinforce the point that was made earlier that, you know, the problems at this stage, in my mind at least, are conceptual rather than implementation-type problems. And if somebody has come up with a way to get over the conceptual hurdle, then, by gosh, we ought to know about it and maybe we ought to get some guidance from them.

MEMBER APOSTOLAKIS: Yes.

MEMBER MAYNARD: I don't believe that we've really utilized the other industry information as well as we -- nuclear power, the reactor protection, and the control systems are really not at all complex when you compare it to many of the other systems that have been out there in other industries.

MEMBER APOSTOLAKIS: Exactly.

MEMBER POWERS: And if I had a dollar for every time that has been said in this room, I would have enough to pay for lunch, certainly. Or dinner. Maybe even dinner.

MEMBER MAYNARD: I don't have to pay a dollar for saying it again, though, do I?

MEMBER POWERS: Yes, you will. If you say it again, it's going to cost you two bucks. Okay?

(Laughter.)

MEMBER APOSTOLAKIS: That is all, Mr. Chairman.

CHAIRMAN SHACK: Are we finished?

MEMBER APOSTOLAKIS: Yes. Break for two hours?

(Laughter.)

CHAIRMAN SHACK: Back at 10:45.

(Whereupon, the proceedings in the foregoing matter went off the record at 10:30 a.m. and went back on the record at 10:49 a.m.)

CHAIRMAN SHACK: Let's come back into session.

Our next topic is a Commission paper on staff's recommendation to make a risk-informed and performance-based revision to 10 CFR Part 50. And that's Dr. Kress leading us through this.

MEMBER KRESS: Thank you, Mr. Chairman.

I just want to remind the Committee that this is not about the technical issues associated with the framework. This is about the staff's recommendations on how to proceed or whether to proceed with the rulemaking on risk-informing -- or making it a risk-informed Part 53, and I think as well as whether they should undertake any risk-informing of specific regulations, like 50.46, for example.

So this is not about the technical issues. This is just about those things. And with that, I'll turn it over I guess to -- Joe, are you going to lead off for the staff?

MR. BIRMINGHAM: Yes, thank you.

MEMBER KRESS: Okay.

MR. BIRMINGHAM: Good morning. I'm Joe Birmingham in the Office of NRR and the rulemaking section. With me is Marty Stutzke of NRO and Mary Drouin from Research. Also with us is Eileen McKenna, who has been NRR and just recently transferred over to NRO, and John Monninger, also of Research.

It's a good thing to point out that this is not on the technical issues in the framework, but this is the -- on the recommendation. The purpose is to provide the ACRS information on the staff's recommendation on the reactor requirements for advanced reactors, and also to inform you of the stakeholder comments on the plan to risk-inform 10 CFR Part 50 for future reactors, also on the policy issues that were included in the ANPR, and the technology-neutral framework itself.

Here's a brief history, starting in January 2003. The Office of Research, advanced reactor research plan recognized the need for a licensing framework for advanced reactors. This was based on the fact that the current reactor regulatory structure focuses on lightwater reactors and it has limited application to non-lightwater reactors.

Advanced reactors will have design and operational issues that are different from lightwater reactors. The current reactor regulatory structure contains requirements that are not really applicable to advanced reactor designs, and that it had evolved with limited insights from PRA and severe accident research.

We expect that PRA and PRA insights will be an integral part of licensing of advanced reactors, and after this program was begun to develop a risk-informed performance-based regulatory structure that could be technology-neutral to support future licensing.

As an ANPR background, in January of 2006, the Commission directed the staff to issue --

MEMBER APOSTOLAKIS: I am curious why somebody took the trouble to say that "could be technology-neutral." I thought it was. On the previous slide. Clearly, this is something somebody demanded, unless I'm wrong.

MS. DROUIN: I think that's just, you know, it is technology-neutral.

MEMBER APOSTOLAKIS: It is.

MS. DROUIN: That word could have been -- would be technology-neutral. But I think it was written that way because we're going back to 2003, and, you know, it could be.

MEMBER APOSTOLAKIS: All right.

MS. DROUIN: Don't read any more into it than that.

MEMBER APOSTOLAKIS: Okay.

MEMBER KRESS: It wasn't all that certain back then --

MS. DROUIN: Back then.

MEMBER KRESS: -- that you could do it.

MR. BIRMINGHAM: Okay. On the ANPR, in

January 2006, the Commission directed the staff to issue the ANPR, and to provide its recommendation on whether, and, if so, how to proceed with rulemaking. The Commission also requested staff seek stakeholder input on three areas -- on the technology-neutral framework, on the advanced reactor policy issues that were included in the ANPR, and on the plan to revise reactor requirements for advanced reactors.

The Commission directed the staff to facilitate stakeholder participation by holding public meetings, workshops, soon after the ANPR was issued. In January of 2007, the staff began meeting with the Advanced Reactor Steering Committee on its proposed recommendation for reactor requirements for future reactors.

We discussed options in light of stakeholder comment that we should test the draft requirements. We discussed the impact on design certifications and combined operating licenses. Also, the impact on the NGNP schedule and the impact on far-term projects such as the GNEP.

In March of 2007, the staff completed its preliminary review of stakeholder comment and drafted a Commission paper.

MEMBER APOSTOLAKIS: So the advance notice was issued when?

MR. BIRMINGHAM: March.

MEMBER APOSTOLAKIS: Of '06 or --

MS. DROUIN: No.

MR. BIRMINGHAM: May of '06? May of '06.

MS. DROUIN: May of '06.

MEMBER APOSTOLAKIS: May of '06.

MS. DROUIN: First of May.

MEMBER APOSTOLAKIS: So you went through what the Commission required. You had workshops, you had --

MR. BIRMINGHAM: Yes. We held a public meeting to discuss with stakeholders what was in the ANPR, and then we held a two-day workshop to collect their comments, and also they made some presentations and we went through the -- we furthered a lot. We got a lot further with some early stakeholder input that way.

MEMBER APOSTOLAKIS: So when you say "staff discussed options," you are going come back and tell us what the options were on these issues later in the talk or --

MR. BIRMINGHAM: We could. What we are going to tell you is what our actual final recommendation is --

MEMBER APOSTOLAKIS: Okay.

MR. BIRMINGHAM: -- going to be.

MEMBER APOSTOLAKIS: Yes. Maybe the final recommendation, then, we'll talk about.

MR. BIRMINGHAM: We went through several variations and options with the Steering Committee, but we determined not to go down those paths.

MEMBER APOSTOLAKIS: Okay.

MR. BIRMINGHAM: I wanted to let you know who the stakeholder comments were from. As you go through this list, you notice that it represents primarily industry, industry vendors, industry codes and standards groups. We did not actually get a lot of public participation from what I would call the general public.

I think that's partly because at this time the general public probably doesn't have a vital stake and interest in advanced reactors for them to be built in the future. We expect that they'll get more involved as we get closer.

MEMBER WALLIS: But there's no measure of how well your plans go down with the public as opposed to the industry, except through the --

MR. BIRMINGHAM: I think that's a relatively fair statement. We've had a lot of public

-- general public participation on risk-informed rulemakings that we were present. But when you start talking about distant future, the public kind of doesn't focus that way.

MEMBER APOSTOLAKIS: When you say "public," do you mean the so-called intervenors?

MR. BIRMINGHAM: They would be part of the public, general public, yes.

MEMBER APOSTOLAKIS: Is there anybody else ever showing up?

MR. BIRMINGHAM: Oh, we did get a minor comment from people like Dave Lockbaum that, you know --

MEMBER APOSTOLAKIS: We are all part of the general comment, you know.

MS. DROUIN: I mean, if you look at the list there, the nuclear equipment quorum, that's really a one-person --

MEMBER APOSTOLAKIS: Which one? Oh.

MS. DROUIN: Nuclear equipment quorum. I don't remember his name, but it's not this huge company. It's a one-person company, and that's the name of his --

MEMBER APOSTOLAKIS: But they are all industry-related people.

MEMBER ARMIJO: But everybody got a chance, right? Everybody got --

MEMBER MAYNARD: And there are a number of groups that monitor -- the fact that they didn't issue comments doesn't necessarily show they support it or don't support it, but they had an opportunity, and I think by not providing any comments at least shows they're willing to listen and wait and see what happens.

MS. DROUIN: Well, and I will also add you have to see that when you look at -- you've got it from ASME and ANS. And on ASME and ANS, on the Committee, it's not just industry.

MEMBER MAYNARD: Right.

MS. DROUIN: Because, you know, these committees are balanced, you know, across the different stakeholders. So you'll have people there from perhaps an insurance agency. So in that way you have received it indirectly from the professional societies.

MEMBER APOSTOLAKIS: But I think there is a real question here.

MEMBER WALLIS: What's very interesting, though, is to me the requirements for future reactors, and so safety requirements, fundamentally they're imposed for the benefit of the public. They're not imposed for the benefit of the industry. The people with the biggest stake in all of these things are the public, and somehow they don't get into the equation. I'm sort of puzzled by that.

MEMBER APOSTOLAKIS: But at the same time, though, I mean, the NRC staff goes out of its way to announce these meetings. If they don't come, they don't come. What can you do?

MEMBER KRESS: To some extent I think we kind of keep in mind the public's interest in our --

MEMBER APOSTOLAKIS: I think we try to do that.

MEMBER KRESS: We try to do that.

MEMBER APOSTOLAKIS: In all fairness, I think the staff tries to do that, too.

MEMBER KRESS: And the staff tries to do that.

MEMBER APOSTOLAKIS: In my mind, the biggest public interest group when it comes to nuclear power is the NRC staff.

MEMBER MAYNARD: I agree with that.

MEMBER CORRADINI: So can I go back -- don't go back a slide. I just had a question on the last slide. Who is the Steering Committee? Did you say that and I missed it?

MR. BIRMINGHAM: The Advanced Reactor Steering Committee. It's an interoffice group primarily from -- headed up by NRO.

MEMBER CORRADINI: So can you give me a few names?

MR. BIRMINGHAM: Well --

MS. DROUIN: Tom Bergman.

MR. BIRMINGHAM: -- knowing who the --

MEMBER APOSTOLAKIS: Who is chairing it?

MR. BIRMINGHAM: Yes, who is --

MS. DROUIN: Tom Bergman.

MR. BIRMINGHAM: Tom Bergman is, but he's sort of the new reactor office representative on there for Borchard and David Holihan, for example. But then you also have people on there from NMSS, and Research is represented, NRR, and then you have -- as necessary, other offices will participate.

It's an interoffice one but with --

MEMBER CORRADINI: You answered my question as if it's a basketball team and there's five starters and the starters rotate in. Is that true? So you might have five --

MEMBER APOSTOLAKIS: No. It's like the government of Switzerland. They do rotate.

MEMBER CORRADINI: Oh, okay. Fine.

MR. BIRMINGHAM: I don't think I'd put it quite like that. I think you have sort of a main core, and five starters tend to show up for all the same meetings, but then you have additional people who come off the bench.

MEMBER CORRADINI: Got it.

MR. ADER: Hey, Joe? Charlie Ader from the staff.

MEMBER CORRADINI: Are you a starter?

(Laughter.)

MR. ADER: I'm a member of the Steering Committee. Tom Bergman is chairing it. We're transitioning. I'm going to end up chairing it probably later this month. Farouk Eltawila from Research; Mark Cunningham, Research; Mike Mayfield; Joe Gitter from NMSS. I'm sure I'm forgetting somebody else, but that's the main players.

MEMBER CORRADINI: Thank you.

MEMBER KRESS: On these stakeholders, I would think what the PBMR people said would be very interesting, because they seem to have the most different reactor concepts of the --

MS. DROUIN: Well, you would have thought. But the PBMR comments were about four pages, and they deferred to the NEI comments, and they agreed with what was in the NEI comments.

MR. BIRMINGHAM: I think it would be worth bringing out, though, they were at the workshop and --

MS. DROUIN: Yes.

MR. BIRMINGHAM: -- you know, they had quite a few comments at the workshop that they offered, you know, and -- so we got quite a bit of input from them, but they do have a slightly different approach.

Okay. Let's get back to Slide 7, the ANPR comment areas. We asked for comment on three areas -- the plan to risk-inform 10 CFR Part 50, the policy issues including level of safety, integrated risk. We requested feedback on the ACRS letter on those issues. The area of defense in depth, the single failure criterion, containment performance standards, integration of safety, security, and emergency preparedness, and the framework itself.

Any question on the depth that we went into or anything on those issues?

MEMBER APOSTOLAKIS: So the framework refers to the technology-neutral.

MEMBER KRESS: It refers to the document, the NUREG.

MR. BIRMINGHAM: The document.

MEMBER KRESS: Are we back on the ACRS letter?

MEMBER APOSTOLAKIS: What, we're going to talk about these things at some point?

MR. BIRMINGHAM: Yes.

MEMBER APOSTOLAKIS: Okay.

MR. BIRMINGHAM: That's coming. Stakeholder comments. As on the plan to risk-inform 10 CFR Part 50, stakeholders were generally very supportive of the design of risk-informed requirements, but strongly suggested that the staff, one, not do anything that adversely impacts on the near-term licensing and development of the design certs and COL applications.

They asked that we continue the current efforts for risk-informed rulemaking, such as the local loop rulemaking.

MEMBER KRESS: Is that 50.46?

MR. BIRMINGHAM: Yes.

MEMBER APOSTOLAKIS: Yes.

MR. BIRMINGHAM: They also asked that we develop preliminary draft requirements that they could see and be able to discuss. We wouldn't be requesting comment at that point, but it would be something that we'd make available.

MEMBER APOSTOLAKIS: It's for limited draft requirements imposed on future reactors?

MR. BIRMINGHAM: The preliminary draft requirements that would be imposed on future reactors that would be based from the framework.

MEMBER APOSTOLAKIS: So that's related to the first sub-bullet of the second group, review and approve non-LWR application?

MS. DROUIN: What they were talking about here is they'd like to, in essence, see a draft Part 50. And we'll talk about --

MEMBER APOSTOLAKIS: But then, they turn around. They tell you approve non-LWR application using Part 50/52.

MR. BIRMINGHAM: Correct.

MEMBER APOSTOLAKIS: That tells me that they want to do what Exelon was proposing a few years ago. We'll take Part 50, but because our reactor is gas reactor, here are the changes we are proposing. Is that different from developing preliminary draft requirements?

MR. BIRMINGHAM: Yes. What they asked us to do is develop what -- based on the framework, to develop preliminary draft requirements and what we expect that Part 53 would look like. They wanted the opportunity to comment on that, to -- you know, to understand better how that would affect future reactors, and then they wanted sort of like a pilot to use a non-lightwater reactor, which in this case would probably be a high temperature gas reactor, and then to use that as a pilot to test how well this would apply to it and whether or not it would cover it completely, whether appropriately, or, in their opinion, whether we were too conservative.

MEMBER KRESS: It seems to me like if an applicant, wanting to tailor the current Part 50 to his reactor, having such draft requirements would be useful to both you and the --

MEMBER APOSTOLAKIS: Isn't that what we recommended also recently?

MEMBER KRESS: I think that was -- that was within our recommendations.

MEMBER APOSTOLAKIS: If a framework can apply to -- yes, okay.

MEMBER CORRADINI: I guess that's a question I had. So this is in some sense in parallel to the technology-neutral framework, and I guess the response in the letter that was crafted essentially suggests almost a test run -- a test drive. Yes, okay.

MS. DROUIN: And that's what this was getting at.

MEMBER APOSTOLAKIS: The letter never went out, right?

MEMBER KRESS: I don't know. Yes, I think it did.

MS. DROUIN: Your letter has been issued.

MEMBER POWERS: Could I understand better why you would apply it to a reactor for which the results are not known and not apply it to a reactor for which they are known.

MEMBER KRESS: Like a lightwater reactor?

MEMBER POWERS: Sure.

MEMBER KRESS: That's interesting, because they are an appendix in the NUREG where it actually does attempt to do that. And I thought that was a good idea.

MEMBER APOSTOLAKIS: Mary mentioned Part 53. There is a 52. What's the difference? I should probably know, but I know what Part 50 is, and I know what Part 52 is. Is there a Part 53?

MS. DROUIN: No.

MEMBER APOSTOLAKIS: Ah, okay.

MS. McKENNA: This is Eileen McKenna from the staff. Let me speak to that briefly. I think what we're referring to here, and where it says Part 50/52, is really talking process that you could -- one could apply for a license under Part 50, when under the construction permit or operating license philosophy like we did in the past, or one could come in under the Part 52 process for design certification and potentially a combined license.

But in either case, in the -- whether you are under 50 or 52, the technical requirements were in Part 50. Here what we're talking about in Part 53 is you would establish this new set of technical requirements for -- that are more risk-informed and performance-based instead of using the Part 50 requirements.

Now, whether -- what licensing process one used with that is something I think that, you know, whether we would embed within 53 the licensing process requirements, or we would continue to use, say, the 52 licensing requirements, I don't think we've quite settled in terms of what the -- exactly how the rule language would look in that regard. But there's the process elements and there's the technical elements that you need to be clear.

MEMBER APOSTOLAKIS: There is no Part 53

right now.

MS. McKENNA: No, I think that was jus ta term of --

MEMBER APOSTOLAKIS: Oh, okay.

MS. McKENNA: -- art.

MEMBER APOSTOLAKIS: Okay.

MS. McKENNA: To refer to --

MS. DROUIN: That's our internal term.

MS. McKENNA: I think to --

MEMBER APOSTOLAKIS: And now it's my internal --

MS. McKENNA: Yes, I think it was to -- rather than trying to change Part 50, you would make a new part.

MEMBER APOSTOLAKIS: It was an innocent question.

MS. McKENNA: No, no, no. Didn't mean anything by it.

MEMBER KRESS: I don't think Dana got a good answer to his questions, why apply it to a non-LWR reactor when you don't know how to compare the results with anything. So could you address that perhaps?

MR. BIRMINGHAM: I'm going to try, and then I'm going to ask Mary to kind of correct me a little bit. I believe that in developing the framework that he actually did apply many of the draft requirements that they thought applied to a lightwater reactor, to see how they --

MEMBER KRESS: Yes. But I'd like to twist the question around and say, "What would be the purposes of applying it to, say, an HTGR or a non-lightwater reactor?" What would you learn from that?

MR. BIRMINGHAM: Because the agency and the staff are so lightwater reactor-oriented, we tend to focus on things like ECCS and protecting the fuel from, you know, being uncovered and so on. And yet a high-temperature gas reactor where you could be -- have something totally different like pebbles, be a pebble bed modular reactor where the concept of an ECCS system or uncovering the core are totally different.

And the staff isn't oriented that way in the past. So applying it to a non-lightwater reactor to see if we were -- had appropriately captured the right requirements for this non-lightwater reactor and that we covered the entire scope of what needed to be done, and yet at the same time not imposed superfluous requirements, that, you know, if you're trying to be technology-neutral, would a, you know, ECCS system make sense for a gas reactor? Of course, the answer is probably no, but what do you need that -- to form on it and do these risk-informed requirements to cover that?

Does that kind of answer the question why we would do it? It would -- it's a test case.

MS. DROUIN: I think what you have to look is understand there is -- when you look at the framework, you know, you can look at it for one area, which is the probabilistic approach. That, you know, is a major element of the framework. That we tested against the LWR to see, okay, could you really use a probabilistic approach for your licensing basis.

And we used that and applied it to an LWR to see what would come out of it, and then how would it compare to, you know, we have these already set-up DBAs for this. And, you know, how did our events come out compared to what they're currently licensed against to see if that approach would work?

Bar that to -- the framework is also -- was criteria for developing not just your licensing base event selection, but to create a whole set of your technical requirements. You know, that would be a replacement of the technical requirements of Part 50. To apply that to an LWR, why would you want to do that? I guess is my question, because --

MR. BANERJEE: But have you done it? Have you done it?

MS. DROUIN: No.

MR. BANERJEE: Have you applied it to an LWR to see if --

MS. DROUIN: No.

MR. BANERJEE: -- it works?

MS. DROUIN: I don't know what you would see to work I guess. That's what I'm saying. The part that you would want to see working is the risk part.

MR. BANERJEE: Well, let me -- in my mind, this is like a vehicle. And the first thing to do is test it on the roads and then take it off road. And this is supposed to work everywhere, right?

MS. DROUIN: No, no, I understand. But what we have done -- what we have done is look at, you know, what would be the requirements that would come out of using the framework to create this Part 53, and we compared that to here's the technical requirements in Part 50, and how -- I mean, that isn't in a sense testing it. I mean, you're looking at here are the technical requirements for Part 50, here's the --

MR. BANERJEE: Then, you are testing it.

MS. DROUIN: In that sense, yes.

MEMBER WALLIS: Just showing that you come up with the same requirements, which are the good requirements.

MS. DROUIN: We were trying to see, you know, where the differences were. Did we -- you know, are they the same? Are --

MEMBER WALLIS: Are they any better, or are they --

MS. DROUIN: All of that is what we look at.

MEMBER APOSTOLAKIS: But, Mary, the way I understand it, technology-neutral framework, it will set high-level requirements. But then, for a specific technology, you may go beyond what the framework says, right?

For example, the framework right now is in terms of dose, frequency of dose, right? It does not refer to core damage, does it?

MS. DROUIN: It does not refer to core damage.

MEMBER APOSTOLAKIS: Right. But it's conceivable --

MS. DROUIN: Core damage is a lightwater reactor term.

MEMBER APOSTOLAKIS: Right. It's conceivable now, if I were starting from scratch and I had lightwater reactors and other reactors, that for lightwater reactors I would develop requirements that involved core damage frequency. That's not inconsistent with the framework, is it?

MS. DROUIN: No.

MEMBER APOSTOLAKIS: It's not.

MS. DROUIN: No.

MEMBER APOSTOLAKIS: So in that sense, I agree with Mary. I don't think you could learn much by applying it to lightwater reactors.

MEMBER MAYNARD: But I thought in a previous meeting it had been applied to a lightwater reactor to come up with requirements essentially the same but there were some that this process would come out that were a little different than what the current requirements are -- some increase, some decrease. And to me, that does provide you some useful information to see whether the process provides protection of health and safety of the public.

MEMBER APOSTOLAKIS: It seems to me you would learn more by going to a non-LWR technology. I'll give you an example. Three or four years ago the proposed framework was in terms of release frequency and core damage frequency. And there were goals, and so on. Then, there was a debate. We got a letter from the HTGR people, from Carl Fleming, and he said, "You guys are talking about core damage frequency, and I don't think that applies to me." Do you remember that?

So you really learn by thinking about application to non-LWRs, unless you --

MEMBER MAYNARD: I agree, George. I was just saying I think they have already done -- I don't think they need to do another lightwater reactor. I think they've already done that.

MEMBER APOSTOLAKIS: I know they did that, yes.

MEMBER KRESS: We'll on technical issues now. I think we ought to get off of them, but let's not dismiss the concept of core damage frequency for any type of reactors. That's --

MEMBER APOSTOLAKIS: I'm not dismissing it. I'm just saying that --

MEMBER KRESS: I just want to be --

MEMBER APOSTOLAKIS: No, but unless you try to -- to see about applying it to another technology, the issue may not even arise. That doesn't mean you are going to dismiss it. But if you keep doing it on LWRs, then we take it for granted that these are quantities that have to be there. And here is another case where some people disputed that, and that's the kind of insight we want to get.

MEMBER KRESS: I think he disputed our particular concept of what might constitute a CDF.

MEMBER APOSTOLAKIS: But the framework now doesn't have that concept.

MEMBER KRESS: I know. But we'll get to that this afternoon.

MEMBER APOSTOLAKIS: Okay. Okay.

MEMBER ABDEL-KHALIK: But just doing the one-step of applying the framework to a non-LWR gas-cooled reactor gives you a piece of information. You don't have the other piece. You need to go through the pain of trying to apply Part 50 to a non-LWR and see all of the exemptions that you have to go through --

MEMBER KRESS: Wonderful.

MEMBER ABDEL-KHALIK: -- and where you would end up, and then you compare the two pieces.

MEMBER KRESS: That's precisely why we recommended that they test it on the PBMR.

MEMBER ABDEL-KHALIK: Right.

MEMBER KRESS: Because you have both of

those elements.

MR. BIRMINGHAM: And I think you'll find that that's what the stakeholders also agree, that we should test it on a non-lightwater reactor, and that's also what the staff agreed to.

MR. BANERJEE: So is the PBMR something that -- I mean, you want to make this book also useful, so is it expected that this reactor is going to come up for some form of review?

MEMBER APOSTOLAKIS: I think the reason why we recommended that in our letter was that we already have a lot of so-called white papers from PBMR that could be used for such an exercise. We already had the mediations. It's not an obligation.

MEMBER KRESS: In the previous application --

MR. BANERJEE: I know there's an application, but --

MEMBER APOSTOLAKIS: But they do --

MR. BANERJEE: -- is there a likelihood of this? I mean, why do we --

MEMBER KRESS: No. We've been telling them that, yes, some -- at some point in time, yes.

MR. BIRMINGHAM: We have the pebble bed and also DOE's NGNP, which is a high-temperature gas reactor, which may or may not be pebble.

Let me move on a little bit, because I think basically we've -- you're in agreement with stakeholders, you're in agreement with staff and with each other.

(Laughter.)

MEMBER APOSTOLAKIS: That's why it was such a short discussion.

(Laughter.)

MR. BIRMINGHAM: With ACRS, you know, a short discussion, five, ten minutes, or what -- what the stakeholders suggested was upon receipt of a non-lightwater reactor, whether it's pebble bed or NGNP, that we review and approach the non-lightwater reactor application using Part 50/52, as Eileen kind of explained how that would work, that we evaluate these preliminary draft requirements against the non-lightwater reactor design, and that this would help us refine the draft requirements before we initiate moving.

MEMBER CORRADINI: So a parallel effort, basically.

MS. DROUIN: Yes.

CHAIRMAN SHACK: Real licensing is done 50/52.

MR. BIRMINGHAM: Right. For the first design.

CHAIRMAN SHACK: For the first design.

MEMBER WALLIS: I'm trying to understand what's happening here. This isn't a plan to risk-inform 10 CFR Part 50. This is a plan to see if there should be a 10 CFR Part 53? Is that what we're --

MEMBER APOSTOLAKIS: Something like that, yes.

MR. BIRMINGHAM: You can put it that way.

MEMBER WALLIS: Because the way Tom presented it I didn't understand. That's what we're talking about. I thought we were talking about all efforts to risk-inform Part 50. If it's something else --

MEMBER KRESS: I think that's in there at some point. Now, we're -- these are the stakeholder comments on the --

MEMBER WALLIS: It says specifically on 53.

MEMBER KRESS: Yes, but these are stakeholder comments specifically on -- I think -- I think their letter to the Commission also addresses risk-informing at --

MEMBER WALLIS: Like 50.46, for instance?

MEMBER KRESS: Yes. So that comes -- they will come up later on that.

MS. DROUIN: The ANPR had the topic of, you know, should we go to rulemaking? And, if so, how? And that was with regard to what we call this Part 53.

MEMBER KRESS: Right.

MS. DROUIN: It could be a 53, it could be an appendix to Part 50, but it was creating this whole complete set of technical requirements for a non-LWR. Also, in the ANPR was another topic was -- should we continue with piecemealing Part 50, doing one regulation at a time, should we take on new regulations, should we stop where we are and just get everything implemented? So those were two separate topics in the ANPR.

MEMBER WALLIS: You don't really know how effective or feasible Part 53 is until you try and write rules that go along with it, do you?

MEMBER KRESS: Yes, that's --

MEMBER WALLIS: And you try to write the document which would actually replace the --

MEMBER KRESS: Well, that would be the purpose of the draft, to get it started.

MEMBER WALLIS: That's very different from constructing a framework.

MEMBER KRESS: But the framework is what guides you on how to make the rules.

MEMBER WALLIS: It might help.

MEMBER KRESS: I mean, I think you have to start with a framework before you make the rules.

MR. BIRMINGHAM: Thank you.

The next part of the presentation is actually on the policy issues that were in the ANPR, and we asked for comments on, and Marty Stutzke is going to cover that area.

MEMBER KRESS: I remind the members that we had a letter on these two policy issues. It was one of those kind of letters on the one hand, and on the other hand --

MEMBER APOSTOLAKIS: I can't hear you. What?

MEMBER KRESS: It was one of the ones for which we had a --

MEMBER APOSTOLAKIS: Some of us and some of --

MEMBER KRESS: -- ACRS member, instead of --

MEMBER APOSTOLAKIS: That's a long time ago.

MEMBER KRESS: It was a while ago.

MR. STUTZKE: Okay. With respect to the policy issues on level of safety and integrated risk, as Dr. Kress had pointed out, the ACRS had provided its reviews in a letter. It's dated September 21, 2005. And it's an interesting letter where some of the members said this and some of them said not this, and --

MEMBER KRESS: Yes, I wouldn't characterize that as interesting, but --

MR. STUTZKE: The context of the letter was you all were being asked to comment on the staff's SECY-05-130 where we had tried to deal with these policy issues. With respect to the level of safety, most of the commenters on the ANPR seemed to support the idea that the minimum level of safety should be established at the quantitative health objectives in the safety goal policy.

What this slide doesn't say that we go into in the letter is, however, there was no consensus on the need or how to define subsidiary risk objectives, like core damage frequency, large early release frequency. The people that commented on it said those need to be technology-specific. They didn't think it could be done generically.

A number of the gas vendors said they didn't think it was feasible to define subsidiary risk objectives for these types of plants.

MEMBER KRESS: That's why you should --

MEMBER WALLIS: Do you mean by -- integrated risk is that several plants on the same site or --

MR. STUTZKE: The idea of integrated risk is multiple plants on a site.

MEMBER KRESS: Multiple modules.

MR. STUTZKE: It grew out of this concern when you have pebble bed modules, six on a site, eight on a site, whatever, how do you look at them. And we broadened it by the time we had written SECY-05-130 to realize we could be dealing with building new plants on existing sites.

MEMBER WALLIS: So, in principle, if a new plant meets the QHOs, that's all it has to do. Everything else is subsidiary and derived --

MR. STUTZKE: No, that's the debate. And there was no consensus among the public comments. Some people were adamant that you need to add up the risk from all the reactors, all of the --

MEMBER WALLIS: Well, that's a different -- I mean, whether it's one or all, it's still QHOs.

MR. STUTZKE: That's right.

MEMBER POWERS: And so a reactor by itself can be evaluated with respect to the QHO.

MEMBER KRESS: Boy, wonderful. I'm glad to hear you say that.

MEMBER WALLIS: Well, how do you apply this, then?

MEMBER KRESS: I didn't hear that.

MEMBER POWERS: I can't tell you whether a reactor meets the QHOs.

MEMBER KRESS: That's exactly right, Dana.

MEMBER POWERS: There's just no way to do it. You have to evaluate it in terms of what site it's on.

MEMBER KRESS: Wonderful. Tried to say that a hundred times.

MEMBER WALLIS: Isn't this why it's not a very good measure?

CHAIRMAN SHACK: Let's not get into that at the moment.

MEMBER KRESS: This is a subject we will have this afternoon, once again. But Dana is exactly right there, and I applaud the statement.

MEMBER WALLIS: That's why it's not used now as a basic health objective, basic design criteria?

MEMBER POWERS: No, it's not used now because it goes well beyond the mandate that is given in the Atomic Energy Act. The Atomic Energy Act only requires adequate protection of the public health and safety. QHOs go well beyond that.

MEMBER KRESS: Yes.

MEMBER WALLIS: If there were a definition of adequate health and safety. Anyway, I guess we have to move on, but --

MEMBER KRESS: Yes, yes.

MEMBER WALLIS: -- we seem to be making some assumption here, which may not be valid.

CHAIRMAN SHACK: Well, they're only reporting what they said. It's not an assumption.

MEMBER WALLIS: Okay. Okay. We're going to get to the bottom line again.

MEMBER KRESS: I mean, the first sub-bullet there is one of the reasons why you shouldn't listen exactly to all the public comments and take them for face value. You should examine them carefully and make your own decision.

MR. STUTZKE: With respect to the Committee's letter, I guess most people believe you guys were asking the right questions. I'll remind you in that letter you took the two policy issues and framed it in the terms of seven questions, and a lot of people thought that was beneficial, although there was a commenter that said, "All of your concerns we already addressed in the framework."

And as far as I know, that commenter wasn't associated with development of the framework. So they were saying it has already been done.

The staff's perspective on these policy issues are we need to wait until we get further down the road with the licensing strategy for NGNP, and our pebble bed pre-application review that is ongoing, before we look for some sort of generic or broad resolution of these policy issues. We don't believe we need them resolved in the near term, because we can license all the future LWRs now without resolving them. We have a path forward, pretty clear acceptance criteria and guidelines, etcetera.

And the only other non-LWRs, you know, that seem to be on the table now or within the realm of consideration are the NGNP and the pebble bed.

MEMBER WALLIS: What does the Commission think should be the basis for licensing future plants in terms of minimum level of safety? Isn't that what you have to go on?

MEMBER KRESS: Yes, I think they're asking the staff's opinion of what that ought to be.

MEMBER POWERS: But isn't the need of the Commission -- the staff has the option of defining what the minimum level of safety is. Congress has defined the minimum level of safety.

MEMBER WALLIS: But it's defined in such vague terms that they can't be used. You have to have an operational definition in terms of --

MEMBER KRESS: In terms of the Commission, and Congress was very forthcoming in saying, "And we leave it up to the Commission to decide what this means," and they have. The fact that you don't like the definition is a problem that particularly affects you, not me. I like the definition.

MEMBER WALLIS: Yes. But if they interpret it in terms of QHOs in an operational sense, so you can now apply something quantitative, is that --

MEMBER KRESS: The purpose is in terms of meeting the current regulations. But when you get to a Part 53, if we ever have one, then I think meeting those regulations may mean something different than meeting the current regulations. So the definition may change if you have a Part 53. At least I think it could.

MEMBER APOSTOLAKIS: I really don't understand why people are so willing to say that the QHOs should be used to establish the medium level of safety. I mean, I can see that happening in the near future, but the QHOs are frequencies, right?

MEMBER KRESS: Yes.

MEMBER APOSTOLAKIS: Per year, on a per year basis.

MEMBER KRESS: Not necessarily.

MEMBER APOSTOLAKIS: They are applied to individual plants or sites, right?

MEMBER KRESS: Individual sites.

MEMBER APOSTOLAKIS: So the total number of sites has to play a role somewhere in the -- as long as we're talking about 20, 30 new plants, that's okay. But if we reach 500, 600, 700, is it still all right? I don't know. I mean, that's a problem of dealing with frequencies.

MEMBER KRESS: I think --

MEMBER APOSTOLAKIS: And everybody seems to say -- to dismiss it. Oh, yes, well, the QHOs are good enough. I don't think they're good enough if you have 1,000 reactors.

MEMBER KRESS: Now you're referring back

to the discussion on safety goals in general.

MEMBER APOSTOLAKIS: Yes.

MEMBER KRESS: And I think it's a legitimate question. I don't think they have to answer that now.

MEMBER APOSTOLAKIS: No, but it has to be noted, though.

MEMBER KRESS: It could be noted somewhere, yes.

MEMBER APOSTOLAKIS: I think it should be noted.

MEMBER KRESS: And I think the QHOs ought somehow to relate to the total number of plants you expect to be out there --

MEMBER APOSTOLAKIS: Right.

MEMBER KRESS: -- in the near future, or the far future even. But I think they have -- I think that was one of the considerations in where they set the QHO level in the first place. And I don't think it has --

MEMBER CORRADINI: It has an assumed population in mind.

MEMBER APOSTOLAKIS: Well, yes, they knew about the 100 units.

MEMBER POWERS: Yes, but there might be

1,000.

MEMBER KRESS: Yes. I think that what they -- what I started to say, I think they assume there might be about 1,000, and they decided on --

MEMBER APOSTOLAKIS: Did they say --

MEMBER KRESS: Now, the QHOs are inherently a cost-benefit consideration, but, you know, they didn't make the cost-benefit. They, instead, finessed that by saying, "Let's set it at such a level that although we don't know what the benefit is going to be, or the cost, we'll set it at such a level we're fairly confident that it meets any reasonable cost-benefit value for 1,000 plants." And this was an intuitive judgment.

MEMBER APOSTOLAKIS: Are you sure it was 1,000?

MEMBER KRESS: I think it was definitely 1,000. But -- and I think it was -- but it doesn't matter, because it was an intuitive judgment, that it was set at such a low value that we meet almost any reasonable cost-benefit --

MEMBER APOSTOLAKIS: But see, your problem, George, it's an individual risk. It's someone who hangs around the outside of a plant. He's not going to hang around 1,000 plants simultaneously.

MEMBER POWERS: He might well do so, if you have -- their zones that can be affected overlap.

MEMBER WALLIS: But you limit it to 10 miles, so they're not going to overlap.

MEMBER POWERS: I think there are places in Connecticut for Millstone, and had they built --

MEMBER APOSTOLAKIS: No.

MEMBER POWERS: -- they would have overlapped.

MEMBER APOSTOLAKIS: No, but this -- still, the number of units matters, because you can ask yourself, now, what is the probability that this will happen anywhere in the United States?

MEMBER KRESS: Certainly the number of units matters.

MEMBER APOSTOLAKIS: Yes, it matters.

MEMBER WALLIS: I don't think this is going to be appropriate --

MEMBER APOSTOLAKIS: It's not an immediate concern. We're not going to build 1,000 of those tomorrow.

MEMBER WALLIS: I'm very surprised the agency hasn't sort of looked at this in terms of licensing reactors. It should be a real solid policy statement about what it's going to be based on.

MEMBER APOSTOLAKIS: There is an expectation that it will do better than this.

MEMBER WALLIS: Yes.

MEMBER APOSTOLAKIS: That's written somewhere.

MEMBER WALLIS: Okay.

MEMBER KRESS: But we're not going to rewrite the safety goals. I think QHOs are a reasonable site-specific criterion at the moment.

MEMBER APOSTOLAKIS: At the moment, yes.

MEMBER KRESS: But I don't -- I agree with you --

CHAIRMAN SHACK: Just remember that line, Tom, we're not going to rewrite the safety goals.

MEMBER KRESS: That's right. We're not going to rewrite them. We may want to augment them.

CHAIRMAN SHACK: Remember that this afternoon.

MEMBER KRESS: But I want to stress once again the safety -- the QHOs are a site characteristic and they are not plant-specific things. And you should be able to separate level of safety of plants from site to a large extent but not entirely. We'll leave that for this afternoon.

MEMBER APOSTOLAKIS: Yes, yes, yes. Well, let's --

MEMBER KRESS: Let's move on.

MEMBER APOSTOLAKIS: So this slide is different from ours.

MEMBER KRESS: Yes, they have two extra boards.

MR. BIRMINGHAM: Mary Drouin said she would like to address the next policy issue which is on defense in depth.

MS. DROUIN: Okay. This goes back, this particular policy issue, to SECY-03-0047, where we first raised seven policy issues to the Commission. And we had recommended to the Commission that a policy statement be developed on defense in depth, defining what it meant.

The Commission, in their SRM, came back and said they agreed that development a definition for defense in depth in a policy statement was a good idea, but for us to consider, instead of issuing a separate policy statement to revising the PRA policy statement. So in the ANPR we raised this as a question to stakeholders to get their input.

Did they like the idea of a policy statement? If they did, you know, was it better to have it in a separate one or in the PRA policy statement? Generally, everybody supported, you know, that we needed a policy statement.

Unilaterally, almost everybody -- I would say,if not almost all of them -- did recommend that we do not revise the PRA policy statement, that it be a separate policy statement. And most of them felt like because it was broader than PRA, and the PRA was limiting, and it should not be tied to that.

You know, they did ask that, you know, we have interaction with them as the development and that would be absolutely, you know, in the development of it that would -- you know, we would have public meetings, etcetera, and doing this.

MEMBER KRESS: But your paper to the Commission doesn't deal with this particular issue? The one we're talking about today.

MS. DROUIN: Sorry?

MEMBER KRESS: Your Commission paper -- don't talk about this issue.

MS. DROUIN: Yes, it does. Yes, it does. And the commitment we have in the paper is that we will start the effort to develop a defense in depth policy statement.

MEMBER KRESS: I didn't catch that.

MS. DROUIN: There's two commitments in

the SECY paper, and this is one of them.

MEMBER KRESS: Okay.

MS. DROUIN: So Marty is going to do the single failure criterion, the next one.

MR. STUTZKE: All right. I would point out we already have through a Commission SRM an agreement or approval that we can seek a probabilistic implementation of the single failure criteria. The issues that were raised in this ANPR were oriented towards, how do we actually implement them?

Most of the commenters did, in fact, favor a risk-informed approach to implementing or to revising the single failure criteria, but without a great detail of how one would actually go about that. There was at least one comment in there that said we have to be careful, we need to realize that single failure criteria doesn't just appear within the Commission's documents, but it's embedded in the codes and standards and things like this. So it's not as simple as the staff waving its magic wand to make something change like that.

In addition, there was another comment that said perhaps we want to pursue --

MEMBER APOSTOLAKIS: Well, excuse me. So that means that even if you develop a new Part 53, you will have problems?

MR. STUTZKE: Well, what I'm saying is, as you know, a large amount of our review is based on licensing meeting codes and standards, for example, from IEEE. So those standards, we would have to take exceptions to them or something like that.

MR. BIRMINGHAM: There were comments from some of the standards and codes committees that they were working on a PRA-based approach to some of their standards, and that -- you know, that those would be potentially available in the future. But they were not -- some of the committees pointed out, as you already said, that it's embedded in their current standards, and you couldn't just suddenly not make it a requirement, because it would still be in the standards.

MR. STUTZKE: Okay. All right. One of the other comments here was maybe we should pursue I guess rulemaking outside of this Part 53, but rulemaking within Part 50 now to revise the single failure criteria as a stand-alone.

Okay. With respect --

MEMBER WALLIS: It's really kind of a stop-gap, because you didn't have a way of evaluating frequency and consequence. A very approximate way of taking a better account of uncertainties and possibilities of something going wrong.

MR. STUTZKE: That's correct. I mean, I --

MEMBER WALLIS: But if you know of a better estimate of the probability of something going wrong, then you ought to use it, right?

MR. STUTZKE: Right. I mean, I was personally struck by the commenter that talked about arbitrary redundancy requirements. Well, arbitrary is in the eye of the beholder, right? And they were imposed because of the uncertainties.

MEMBER KRESS: It wasn't necessarily arbitrary, was it?

MR. STUTZKE: No.

MEMBER WALLIS: It's someone's guess.

MEMBER APOSTOLAKIS: No, it should impose the redundancy. That's what it is.

MEMBER WALLIS: Yes. But it's still someone's guess, so that's good enough.

MEMBER KRESS: Yes. And you have two failure criteria.

MEMBER WALLIS: You have three or four or whatever.

MEMBER APOSTOLAKIS: And, remember now,

single failure does not include human error.

MEMBER KRESS: Right.

MEMBER APOSTOLAKIS: Single human error is not a single failure.

MR. STUTZKE: Okay. Next slide. With respect to the containment performance standards, what the staff had done inside the framework was propose that we treat the containment as a part of the defense in depth, and that we would have functional requirements for containment performance.

We didn't get any general agreement with this. Most of the commenters felt we should develop some sort of containment functional performance requirements at a high level that would be technology-neutral, don't pre-determine the number of barriers that we need, for example, like this. Then, take those concepts and implement them on a technology-specific basis.

A strong comment that came out was don't necessarily presume that you need a pressure retaining containment, if the risk is okay. Like that.

MEMBER WALLIS: Well, the containment isn't there to contain pressure. It's there to contain radioactivity.

MR. STUTZKE: Right. Right.

MEMBER APOSTOLAKIS: But isn't the issue now also the external threats? That even if you don't have a problem internally --

MR. STUTZKE: That's true. I mean, the containment has functions other than to retain the radioactivity, you know. It makes a good shield for aircrafts, this sort of thing.

MEMBER WALLIS: And, also, you can't see what's going on in the plant.

MEMBER POWERS: One struggles to understand how a non-pressure retaining containment would contain the noble gases.

MR. STUTZKE: It doesn't at the moment.

MEMBER MAYNARD: I was struggling with that, too.

(Laughter.)

MR. STUTZKE: All right. This discussion on this policy issue, too, it's inside the SECY paper. It also talked about the probabilistic approach to selecting licensing basis events, and so there were a number of comments on the frequency consequence curve that had been proposed inside the framework.

I guess the notable comment here was the need to add a so-called CCDF curve, complimentary cumulative distribution curve, to this. And the notion -- well, the reason was -- stated was you want to avoid situations where you would reject a design because you had a single bad actor sequence coming up. And I find that statement pretty remarkable, too.

MEMBER APOSTOLAKIS: Say again. What? That you would do that?

MR. STUTZKE: By using the CCDF curve, you would --

CHAIRMAN SHACK: Instead of --

MR. STUTZKE: -- instead of this differential curve that we have, you could still accept designs where you had a single sequence that could cause problems, because you've smoothed it out, you've integrated out the --

MEMBER WALLIS: CCDF is a measure of effect on the public.

MEMBER APOSTOLAKIS: How do you know how that --

MEMBER WALLIS: That's why it's a good curve.

MEMBER KRESS: The problem with that statement is you want to set your requirements such that if you exceed them, if it's a single sequence, then that sequence shouldn't -- you've got to do something about that sequence.

MR. STUTZKE: Exactly.

MEMBER KRESS: Yes.

MR. STUTZKE: Exactly.

MEMBER KRESS: The requirements should be -- I mean, maybe they're not so low that you've got a lot of those, but you need to set them. So I think -- you know, I think that's one comment you want to sort of --

MR. STUTZKE: My personal view is I think we probably need to consider a CCDF curve but not for the reason stated here.

MEMBER KRESS: Yes.

MR. STUTZKE: Just because it's a good thing. But -- and we're in the process of talking about how we could go about that, whether we need to do it.

MEMBER KRESS: Yes. And I wanted to make the point that a CCDF curve can be used as the -- as a representation of CDF and LERF. And we may want to discuss that at some point. But if you want those concepts, which I think you need, for any -- any kind of plant design that's technology-neutral, then I think that's where you get those.

MR. STUTZKE: Yes, I'm well aware of your notes that you gave us.

MEMBER KRESS: You're aware of my --

MR. STUTZKE: Oh, yes.

MEMBER APOSTOLAKIS: Is that something for this afternoon?

MEMBER KRESS: Yes.

MEMBER WALLIS: Yes, it's valid because it's a measure of the effect of the plant on the public, which is really what you're basically trying to do. It's not a regulatory tool, which is what your other frequency consequence curve is. It's actually a measure of the safety status of the plant. Therefore, it's a very valid thing to have.

MEMBER APOSTOLAKIS: The containment is.

MEMBER WALLIS: CCDF. The usual frequency consequence curve is a measure of the effect on society of this plant, and that's what it's for.

MEMBER APOSTOLAKIS: Yes.

MEMBER WALLIS: On this statement --

CHAIRMAN SHACK: It's based on integrated risk, however you define risk.

MEMBER WALLIS: It has nothing to do with regulation.

MR. STUTZKE: Okay. Well, let's defer this until this afternoon. I want --

MEMBER APOSTOLAKIS: Oh. Are you coming

back this afternoon?

MEMBER KRESS: Oh, yes. We're going to discuss all these issues this afternoon.

MR. STUTZKE: The last policy issue that was discussed in the ANPR was this integration of safety, security, and energy preparedness. And in general, stakeholders had problems --

MEMBER WALLIS: But you never did it in the framework. Discussed it, but it never happened.

MS. DROUIN: This was in the ANPR, because --

MEMBER WALLIS: It was in the ANPR, yes.

MS. DROUIN: We're responding to the ANPR here. The Commission in several of their SRMs said integrate this. So, and they did this in the SRMs that told us to put it in the ANPR, so we solicited stakeholder input. And this is not necessarily just related to the framework. It was -- they had been telling us, regardless of the framework, whether or not to integrate these three things, so we sought stakeholder input on this concept.

MEMBER WALLIS: So you're talking here about the ANPR.

MS. DROUIN: Yes.

MR. STUTZKE: That's correct.

MEMBER WALLIS: Okay.

MEMBER APOSTOLAKIS: We don't even know what "integration" means. What does it mean?

MR. STUTZKE: Well, the idea would be that you would have to look at security -- how security issues could in fact impact the reactor safety, or vice versa.

MS. DROUIN: Or vice versa.

MEMBER APOSTOLAKIS: Oh, the interaction, you mean?

MR. STUTZKE: The interaction between these two.

MR. BIRMINGHAM: It sort of implies that you would ensure the safety, safety, and emergency preparedness interact seamlessly and that there's no adverse impact by employing any one of them -- of any of those actions.

MEMBER APOSTOLAKIS: So it does not mean that I -- I mean, ideally, if I could calculate it, that I would get a value for the contribution to risk from security or insecurity, and value from safety and then compare the two or put them together to compare with some goal. That's not what it means.

MR. STUTZKE: That's not the intention.

MS. DROUIN: At least that's not our

interpretation. The Commission has not told us what they mean by those words. But the words in the SRM was just, "We should integrate safety, security, and emergency preparedness. That is it. That's the only guidance we've been given."

MEMBER APOSTOLAKIS: But they use the word "integration."

MS. DROUIN: Right.

MR. STUTZKE: Right.

MEMBER ARMIJO: Didn't anybody ask them what they meant? I mean --

MEMBER CORRADINI: Yes. I was going to say, was there any discussion in the -- was there any words in the open discussion that --

MR. MONNINGER: Yes. This is John Monninger from the staff. I think some of the thinking was that, you know, when compared to a traditional operating reactors where a lot of the security is focused on guards, guns, fences, that kind of stuff, you know, if you are in the conceptual design process, are there things that you can do in the design now to improve security? Can you bury certain features, certain safety features of the plant in the bowels, such that it could not be exploited for security-type issues?

So I think that is a lot of the emphasis here. You know, do not -- not to say that security is not known after, but is there something in the design phase where you could more, you know, integrate your approach? I mean, if you look at the -- you know, the vulnerabilities of the plants, systems-wise, you know, layouts, configurations, switch gear rooms, etcetera, you know, you -- they have traditionally been looked at from a safety perspective.

But, you know, where do you actually want those, you know, raceways, you know, to be located within the plant, such that they are not also vulnerable from a security aspect. So I think that was the general thinking.

MEMBER ARMIJO: Good thinking.

MEMBER KRESS: Well, once again, I view those types of things as another design basis accident. I mean, we've talked about design basis threats, and with any kind of DBA or LBE you need figures of merit that have to be met. And that's where I have trouble trying to figure out what the figure of merit is going to be.

If you don't have it in your FC curve you have now, I view that as -- I figure that -- I view that FC curve as sort of a figure of merit. And it's not part of that, so if you're going to integrate, it has to be integrated as a separate design basis accident with a figure of merit. And I don't know what that's going to be, but --

MEMBER APOSTOLAKIS: Why shouldn't it be part of the FC curve? Is that another accident sequence?

MEMBER KRESS: The design basis -- it can be viewed as a design basis accident.

CHAIRMAN SHACK: Yes. I mean, if you treat it as a design basis accident, you don't have to worry about frequency. If you put it in the FC curve, you have to come up with a frequency.

MEMBER KRESS: Yes, that's my point. You don't have --

MEMBER APOSTOLAKIS: Then you put it in a design basis.

MEMBER KRESS: Hmm?

MEMBER APOSTOLAKIS: Then, you put it in the design basis.

CHAIRMAN SHACK: Well, that's a proposal that did not make it through the Commission.

MEMBER APOSTOLAKIS: It did not.

CHAIRMAN SHACK: No, did not.

MEMBER KRESS: But the problem with -- you can't have it on an FC curve, because you don't have a frequency.

MEMBER APOSTOLAKIS: Or you may decide to treat it completely differently.

MEMBER KRESS: Yes, which is what we do now.

MEMBER APOSTOLAKIS: Not pursue it any further.

CHAIRMAN SHACK: Treat it as a beyond design basis accident.

MEMBER APOSTOLAKIS: Yes, and do certain stylized things, and leave it there. Well, the FC curve is below -- beyond design basis.

MEMBER KRESS: The CCDF is, but the FC they use is a design basis --

MEMBER APOSTOLAKIS: You are defining the licensing basis.

MEMBER KRESS: Yes.

MEMBER WALLIS: Yes. But the real FC curve is beyond design basis.

MEMBER KRESS: Yes. Oh, it's all of it.

MEMBER WALLIS: It's all of it.

MEMBER KRESS: It includes the beyond design basis.

MEMBER APOSTOLAKIS: Right. Okay.

MS. DROUIN: Okay. The last topic in the ANPR was the framework. We had placed the framework on the work site when the ANPR was published, and we updated it in the middle of the ANPR comment period in July. Probably I would say at least half of the questions -- I mean, there was over I think like 80 questions. I don't remember the exact number in the ANPR, and I know that probably a good half of them focused on trying to get detailed comments from the stakeholders on the framework document.

MEMBER WALLIS: The framework that was sketched out in the ANPR wasn't quite the same as the framework that appeared in NUREG-1860.

MS. DROUIN: It is the same one.

MEMBER WALLIS: It was exactly the same thing?

MS. DROUIN: There was the initial one that was done in May, and we had some holes in the May version, and the version that was put on -- I think the actual date was August 1st is the version that you all have that he has been giving his comments on.

I mean, we have been revising it a little bit through the public comments, but as the internal document that only -- you know, we have, but the version that's out there is the July version. I mean, in general, you know, at a high level the comments were all very positive.

We've got a lot of detailed comments on the details, and we're still sorting through those to see what -- do we need to make a change in the framework document? But right now we're still on schedule to publish the document in August of this year.

There will be an appendix in the framework that will go into detail summarizing all of the stakeholder comments that we received and how they were dispositioned, published, as I said, in the summer of 2007.

The last part, you know, in the SECY paper of where we're at is that, you know, this is a notation paper. We do have a recommendation in answering the initial question was, you know, whether, and if so, how to proceed to rulemaking.

And our response at this point is that what we're recommending is that the rulemaking -- and when we talk about the rulemaking, we're talking about, you know, creating either -- as I said, it's a packaging thing. Whether it's a Part 53, you know, or whether it's an entire appendix added to the current Part 50.

But, you know, it's this complete set of technical requirements for advance reactors -- that that be deferred until, you know, we get experience with the NGNP and GNEP, and that there is a paper that will be going to Congress on the licensing approach. And that will dictate, you know, the need for developing this Part 53.

MEMBER ABDEL-KHALIK: If you just go with the first green bullet here, and if you take one of these non-LWR designs and go through with Part 50, what do you gain from that experience? You would gain the definition of the exceptions to Part 50. You would identify those.

MS. DROUIN: That's right. For that reactor --

MEMBER ABDEL-KHALIK: With that particular design.

MS. DROUIN: That's right.

MEMBER ABDEL-KHALIK: Now, how would those exceptions that you have identified in going through this process for this non-LWR -- that specific non-LWR design help you with the technology-neutral framework, which is a higher level document?

MS. DROUIN: Well, let's -- when you say a higher level document, I've tried to explain to people that what we -- if you use the framework to generate these new sets of requirements -- the new set. The level of detail would be comparable to what you see in the current GDCs. Everyone thinks it's some higher thing, but it's not. It's at that same level.

MEMBER ABDEL-KHALIK: Well, my understanding is that you would have a higher level document, in conjunction with detail-specific requirements for --

MS. DROUIN: Well, I know people keep saying -- but what I'm trying to tell you is that that has never been the case. This Part 53 that would come out of the framework would be comparable to the current GDCs. They would just be technology-neutral. And if you look at a lot of the GDCs right now, it would not be too difficult to make them technology-neutral, because --

MEMBER WALLIS: Right. Right. They look very good now.

MS. DROUIN: Yes.

MEMBER WALLIS: But the framework doesn't say anything about GDCs.

MS. DROUIN: GDCs is part of Part 50.

MEMBER WALLIS: Well, I'm surprised that

your framework never said that a lot of these GDCs could be carried right over into --

MS. DROUIN: Well, it is in there.

MEMBER WALLIS: I didn't find it anywhere in there.

MS. DROUIN: It's in Chapter 8, and there's a whole appendix.

MEMBER WALLIS: It should be in Chapter 1 or something, when you're setting the stage for the whole thing.

MS. DROUIN: You know, and what we've tried to explain is that that's not the main -- the real difficulty in the framework is the risk-informed part.

MEMBER WALLIS: Well, the whole problem I have with this program is what principle it's based on, and if it's based on some of these GDCs, then, for Heaven's sake, say so.

MEMBER APOSTOLAKIS: Well, let me understand something. The question assumed from Said assumed that you would license NGNP using Part 50 with exemptions. Is that a correct assumption?

MS. DROUIN: Right now, that's the only thing that exists. So unless you create and do some rulemaking, you either are under Part 50 -- you're under Part 50 or 52 for the process.

MEMBER APOSTOLAKIS: But why couldn't you -- I mean, you have to approve the exemptions, right? Maybe another idea would be to start with your framework and try to develop appropriate rules, borrowing as much as you can from Part 50 for NGNP.

MS. DROUIN: That is one -- I believe that is one of the options that they are looking at in the licensing process for NGNP.

MEMBER APOSTOLAKIS: So who is "they"?

MS. DROUIN: NRC and DOE.

MEMBER APOSTOLAKIS: So it's not clear, then, how NGNP will be licensed. It's not automatic to assume that --

MEMBER ABDEL-KHALIK: But this recommendation -- but this implies that you're going to use Part 50.

MEMBER APOSTOLAKIS: No. All they're saying is wait until we have the experience with NGNP. But it doesn't say what type experience it will be.

MEMBER KRESS: I think the framework in the draft rule will give you guidance on how to apply Part 50.

MEMBER CORRADINI: But I guess I viewed this -- I just have to ask a question here. I view this all in some sense ways to think behind the scenes, but the rule is still 10 CFR 50. Period. So if the rule is 10 CFR 50, the only empirical evidence that it works is you go back to Fort St. Vrain, you look at Chapter X, Y, and Z at Fort St. Vrain, and either you follow those DBAs or, with your technique, using the technology-neutral framework or some other methodology, you would modify those DBAs.

And then, the staff would have to come up with a rationalization, the reasoning, as to what goes in and what comes out. Is that -- I mean, isn't practically that what is going to be done? And if you jump in with either it would be the NGNP or the PBMR, those are just more ways to exercise the thinking process. But in terms of pure empirical evidence, the only thing I would go to is what you did historically, because that actually did work under 10 CFR 50.

MS. DROUIN: Yes. And --

MR. BANERJEE: Where the exceptions/exemptions you had to give for Fort St. Vrain or Peach Bottom? Were there many, or are they few?

MS. DROUIN: My understanding is that it was quite a few, and it was a very tedious process.

MEMBER APOSTOLAKIS: But it also depends

on what the NGNP reactor -- who it --

MS. DROUIN: All I can tell you is that --

MEMBER APOSTOLAKIS: Would it be a pebble bed?

MS. DROUIN: That's not known yet.

MEMBER KRESS: Probably not.

MS. DROUIN: It's not known, and --

MEMBER KRESS: Probably not. It's more like a prismatic I think. More likely. I mean, I'm guessing, but --

MEMBER APOSTOLAKIS: You are guessing what, though?

MEMBER KRESS: It won't be a pebble bed.

MS. DROUIN: The DOE --

MEMBER APOSTOLAKIS: Westinghouse consortium I think is pushing for the pebble bed.

MEMBER KRESS: Yes, but there are other people pushing for prismatic.

MEMBER APOSTOLAKIS: Yes. But, I mean, it's not clear who is going to win.

MEMBER WALLIS: Mary, I'm really puzzled. I looked at 10 CFR Part 50, and it doesn't really -- it's not consistent. The framework goes into all this stuff about design basis accidents and safety significant SSCs, and none of that is in Part 50 --

MEMBER KRESS: No.

MEMBER WALLIS: -- that I could find. So it's all in some other part of the regulation. It doesn't -- it's not part of Part 50 itself. So how can you apply Part 50 without all this other stuff which your experience about how to apply it? You're going to take all that other stuff and use it from the NGNP, which is not in Part 50 itself.

MS. DROUIN: I don't want to get into the NGNP.

MEMBER WALLIS: But see, that's the whole thing that I have problems with. You can't just --

MEMBER APOSTOLAKIS: I think you have to go --

MEMBER WALLIS: There's a whole lot of experience and practice and habit, and so on, that you've established in how you use it.

MEMBER CORRADINI: But I guess that's what was my comment.

MEMBER WALLIS: Because that's what you're going to use.

MEMBER CORRADINI: I guess that was my comment. Knowing nothing, you would have to go back to all of the experience and practice established for the one plant that had helium --

MEMBER WALLIS: Right. And you had to go back and --

MEMBER CORRADINI: -- that had a graphite moderator that would --

MEMBER WALLIS: Two.

MEMBER CORRADINI: Two, whatever. I'm sorry, two. But essentially you had to worry about pressurized loss of flow accidents, depressurized loss of flow accidents, air ingress, water ingress, and those are the natural things that are going to kind of pop out whatever technique you use.

MEMBER WALLIS: Do you go back to experience, or you use something like this framework in order to --

MEMBER KRESS: Well, the framework has to identify classes of LBEs. And what he's saying is right, you don't have any way to do that except what has already been done and brainstorming it and thinking about it.

MEMBER WALLIS: But Part 50 doesn't say you have to have classes of LBEs and all that stuff. That's something else that is laid on by the staff.

MEMBER APOSTOLAKIS: I don't understand that. I mean --

MEMBER KRESS: Except that is the way it

has always been done under Part 50.

MEMBER WALLIS: that's the way it has already been done, but I thought this was an opportunity to do something different.

MEMBER APOSTOLAKIS: They will have done a PRA, and I understand the pebble bed people have already done it. Then, you go to the framework and you define the LBEs. Now, that's easier said than done, but at least you -- there is a way forward.

MEMBER KRESS: But LBEs don't come out of the PRA.

MEMBER APOSTOLAKIS: Sorry?

MEMBER KRESS: There are additional LBEs that don't come from the PRA.

MEMBER APOSTOLAKIS: Well, they could.

MR. BANERJEE: It's very hard to do a PRA when you don't know what you're going to find.

(Laughter.)

But, look, with a pebble bed you could get hot streaking, you can get all sorts of phenomena you've never seen before. How the hell are you going to do it?

MEMBER APOSTOLAKIS: But the PRA -- look, they didn't do it in isolation. They had reviewers. Somebody raised that issue, and they have an answer.

I mean, I assume --

MR. BANERJEE: I'm just raising these issues. They could be 10,000 others.

MEMBER CORRADINI: But, I mean, just go backwards, though, Sanjoy. How did they do --

MR. BANERJEE: Yes.

MEMBER CORRADINI: -- WASH 1400 with Surry and Peach Bottom at the time, right? They essentially developed a whole range of very conservative what-ifs in terms of how the accident could release source -- could release fission products and then generate a source term offsite. But in some sense in '72 it was only the same --

MR. BANERJEE: I'm just saying I want a PRA on this matter, you know, that --

MEMBER KRESS: That's the prime argument for going to licensing basis event.

MEMBER WALLIS: Think of the evolution of ECCS. I mean, you didn't have to have ECCS, and there is all kinds of ECCS hearings and tremendous debate before we came up with some kind of a criteria and stuff for ECCS. Is this going to happen with these other reactors?

MEMBER APOSTOLAKIS: I think we are speculating now.

MEMBER KRESS: Yes.

MEMBER WALLIS: No, but you don't know what can happen to them. So how are you going to evaluate what all the accidents are?

MEMBER APOSTOLAKIS: At this point, we don't --

MEMBER KRESS: Can't get away from --

MEMBER APOSTOLAKIS: I don't think -- I mean, if you have a problem defining the signals that's in the PRA, I just don't see how the traditional design basis will have no problem. I just don't see that. But it's the usual thing, you know, beat on the PRA and you hurt a few people.

(Laughter.)

I don't understand that. Explain to me why the incompleteness issue is more serious in the PRA than in the other --

MEMBER POWERS: It's just so uncertain, George.

MEMBER APOSTOLAKIS: What?

MEMBER POWERS: It's just so uncertain. It's all very speculative.

(Laughter.)

MEMBER WALLIS: No, it's not. The PRA is integrated with the design, and it --

MEMBER POWERS: Yes. But at least it's a systematic search for things that can go wrong.

MEMBER KRESS: I think we've gotten off the track.

MS. DROUIN: We're done.

MEMBER KRESS: You're done?

MS. DROUIN: We're finished.

MEMBER KRESS: Do you expect a letter from us on this? Because I'm thinking about writing one. But I --

MS. DROUIN: I will defer that to Eileen.

MS. McKENNA: Well, I think if you go back to our first slide, we had indicated we were providing it for the Committee's information. Obviously, the Committee can do what it chooses, but we're not specifically asking --

MEMBER WALLIS: Your bottom line is --

MEMBER KRESS: We would write one if we were supportive.

(Laughter.)

MEMBER APOSTOLAKIS: No, no.

MEMBER WALLIS: Everybody said the bottom line --

PARTICIPANT: Well, your last letter was supportive, right?

MEMBER KRESS: Well, of course it was. Yes. Yes.

MEMBER APOSTOLAKIS: If you have momentum that way, yes, keep writing them.

MEMBER KRESS: Okay.

MEMBER ABDEL-KHALIK: Really, back to the two requirements together, the implication is that you're going to use current Part 50 to license one of these machines, and then go back and reexamine this technology-neutral framework.

MR. BIRMINGHAM: Kind of do it in parallel with the licensing process and apply them as they went along, so we, you know, would have an opportunity maybe to request additional information. I don't know if you could do it to -- you could do it at least --

MEMBER KRESS: A recommendation on defense in depth or --

MEMBER ABDEL-KHALIK: It seemed to me when I read this -- implied that you're going to do them in sequence rather than in parallel.

MS. DROUIN: The licensing strategy is -- the licensing strategy -- whatever is decided on the licensing strategy -- and right now there has been no decision made on the licensing strategy. There is a working group that has been put together with DOE and

NRC that is developing this licensing strategy.

It is the results of that licensing strategy is what we will use to determine, you know, if and how we should move forward.

MEMBER WALLIS: How does an applicant know what to submit if he doesn't know what the strategy for licensing is?

MR. STUTZKE: Okay.

MEMBER ARMIJO: Well, the PBMR people have very clear guidance, right?

MEMBER WALLIS: Looked just like the framework. They were sort of copying the framework and --

MEMBER KRESS: No. I think they came before the framework. But I think at this time, Mr. Chairman, I'll turn it back to you.

MEMBER APOSTOLAKIS: Very good.

MEMBER KRESS: And I'd like to thank the staff for a very interesting -- we'll have an interesting discussion this afternoon.

CHAIRMAN SHACK: We'll adjourn for lunch until --

MEMBER WALLIS: What's this training we have to have?

MEMBER KRESS: That's tomorrow.

CHAIRMAN SHACK: That's tomorrow.

PARTICIPANT: Mr. Chairman, when do you want us back?

MEMBER APOSTOLAKIS: 1:15, right?

CHAIRMAN SHACK: 1:15.

(Whereupon, at 12:05 p.m., the proceedings in the foregoing matter recessed for lunch.)

CHAIRMAN SHACK: It'S time to come back into session. Our next topic is the Status of Development of an Integrated Long-term Regulatory Research Plan and Dr. Powers is going to be taking us through this.

MEMBER POWERS: I guess -- I hope all the members are aware that ACRS every other year, writes a report on the NRC's Research Program. Those of you that have some tenure on the Committee are aware that in every one of our Research Reports we usually include a paragraph or two that decries an absence of longer term research and that so much of the research is tied directly to issues of immediate regulatory concern. And I can honestly say that our reports have had some real impact since, after each one the amount of longer term research seems to be curtailed a little more and --

(Laughter)

-- and more of the research is focused on immediate regulatory consensus. We can have some confidence that that won't happen this time because I don't think there's anything left to curtail. The staff has, however, undertaken at the Commission's request and not in response to our Research Report, an effort to identify some longer term research and they're here to discuss that with us. They did spend a substantial fraction of yesterday talking to us about what they had found in their efforts to identify and I can say that the thrust of their examinations of longer term research have not paralleled exactly the kinds of things we were thinking about but certainly a subset of them.

They have identified -- established some criteria and identified some areas of research and prepared a list of candidate research topics that have yet to be prioritized but presumably would be. Yesterday, we spent, as I said, the substantial portion of the day just going through the list. They've not developed any of these research topics aside from the identification. And clearly they cannot go through in that detail.

So we've asked them to provide a synoptic account of both the processes they went through and describe not each one of the research activities but to give us some illustrative examples. So I'm sure that they are prepared to answer questions on any of the topics. You will get the complete list of topics but their prepared comments will be on just a subset of those. And with that, do I turn to you, Brian?

MR. SHERON: Yeah, I'll give some introductory remarks. I'm Brian Sheron, Director of the Office of Nuclear Regulatory Research. And first I want to thank you for letting us be here today to talk about this. For those of you that were here yesterday, you'll probably hear something that sounds a little similar but basically this was started -- I had one of my periodics with the Chairman and he asked me what the office was doing looking towards the future and, of course, you know, I think our planning horizon was basically the next three years which is our budget cycle. And I explained what we were doing and he said, "No," he says, "I'm talking about like five, 10, 15 years from now, what challenges will this agency be faced with and what are we doing to prepare to meet that challenge".

And I said, "You know, we really hadn't thought about it and really hadn't planned out that far". And you know, I said that, "Had I done this five years ago, I'd be planning for decommissioning today". Things change and the like. And he recognized that but he -- you know, he felt that we should be -- he's a very -- I'll be quite honest. He's a strategic thinker. He thinks the Commission should be looking, you know, five, 10 years out to see where we ought to be and I think he feels that the Office of Research should be at least looking to see what do we need to be prepared to deal with in the long-term.

And so I took that as a challenge and said that we would take a long look. He also was very interested in providing. I think that's one of the -- to answer Dana's concern. You know, one of our problems has always been that you know, when we focus on the immediate needs, it pretty much eats up most of the funding and the like. I don't think there's any reluctance on the part of the Office to want to do this longer term research. It's just been a matter of priorities.

But anyway, we undertook this effort and I asked Christiana Lui who is the Deputy Director under Farouk Eltawila in DRASP, I asked her if she would head this up and actually kind of took her out of her job and made this a special assignment. We let an SES Candidate Development Program individual come in and act for her in her normal job. And Chris has had the able of the staff here. Nathan Siu, Don Helton and I guess -- is Rob here?

MS. LUI: Rob will join us shortly.

MR. SHERON: Okay, and Rob Tregoning provided a substantial part of the help but I do want to give credit to the rest of the research staff. One thing I wanted to do was to get their collective thinking on this. So I issued an e-mail to the entire staff, soliciting their ideas on what areas we might be looking at for long-term planning. And again, I'm looking in the five, 10, 15-year range.

We also engaged the other offices within the NRC to provide us with any candidates that they had that they were foreseeing would be needed. We were on kind of a tight schedule. I think the Chairman, when he said it, I expected probably something in a few weeks. We took a hard look at what we could produce and we decided that to at least start this, we would do a two-phrased approach. The first was to try and get a package to the Commission by the end of February. We missed that by a few weeks but that was our goal. And really what we could do in that short period of time, considering this started right around the middle of December, so the first thing you do is you write off the second half of December because of holidays, which means you really can't start into this until the beginning of January and then when you look at concurrence chains, you know, as I said, Chris had few negative days to produce this report basically when you backed off.

But what we did is we wanted to first just have an internal report based on what we found out, what we could predict from the Office of Research as well as the other program offices. And the idea was to send that up to the Commission and also to use that as at least a first shot as a planning wedge for putting money in the budget in our `09 request for this work. The Chairman did not want to go in with just a blanket, you know, "Give me 5 of give me $10 million and don't worry, I'll do something good with it." He wanted to have something concrete that we could point to and say, you know, "We're requesting this amount of money in the budget for this work", and we would have at least something where we could point to and say, "And these are the specific things that we want to do."

The second step was once we sent this

initial cut of the report up to the Commission, would be to engage other stakeholders which includes the ACRS, industry, National Laboratories, universities, foreign partners, and the like and to get their insights on either if they think we're on the right track, if there's things that we've missed, if we're not focusing on the right stuff. We want to finish that report, the second one by around July. I think the end of July is our goal. And I want to emphasize that this is a work in progress. This is a report t that we think will be updated every year and used as part of our planning for the budget process for the coming year. So what we've identified is certainly not cast in concrete in any way, shape or form.

We're looking for other input. If there is work that turns out to be let me say higher priority or appears to be more important, I think we can make adjustments to work on that and perhaps, you know, work on other things with a lower priority. But that's our plan right now. We would very much value -- I know that the commission, I sat through the last ACRS meeting with the Commission and I think you all had a request from the Commission to look and identify long-term research. So, I hope may this helps you a bit in terms of at least giving you, you know, a stack of many to start with, but we certainly value your input in terms of any suggestions or comments you have on the report. You know, and to the extent that we can get them included in this next version or even in the following years, we would like, you know, to dialogue with the committee on this.

I'm going to turn it over to Chris now. Just, I have a 2:00 o'clock meeting, so I can probably stay for about another 30 minutes or so. So if you have any questions or you want to beat up on me, you've got about 30 minutes and I'll give you that opportunity. Otherwise, I'll turn it over to Chris.

MEMBER POWERS: Please go ahead, Chris.

DR. BANERJEE: Can we beat up on you while talking to Chris?

MR. SHERON: Sure.

(Laughter)

MS. LUI: Good afternoon. My name is Christiana Lui and I'm the Deputy Director for New Reactor and Computational Analysis and I'm currently on special assignment to lead in the development of the long-term research plan as Brian has indicated, and my team members are Nathan Siu, who is sitting on my right-hand side. He's the senior level advisor for PRA and Don Helton, he's the reactor assistance engineer and also Rob Tregoning. He's going to be joining us shortly. He's the senior level advisor for materials.

I'll lead off this part of the presentation by providing an overview and based on like Dr. Powers introductory remark, based on subcommittee's input yesterday, Nathan, Don and Rob will go through sample technical topics identifying the current version of the long-term research plan later on.

We have set out to develop an agency-wide long-term regulatory research plan that will focus on new program areas and any emerging technology that my have inter-nuclear applications as Brian has indicated, that we're looking at a horizon of five, 10 or 15 years from now. And currently the plan is being written at a level supporting budget formulation, so it's a relatively high level description and also we like to use this plan as a communication tool to other regarding where we're going and the type of work that we are looking at and the potential resource needs.

And as Brian has indicated also that we intend to keep this as a living document that will be updated periodically to incorporate new information and also any kind of direction change based on the industry, based on directions from the Commission and based on other input that we receive along that way.

Yesterday we had a lot of discussion, we tried to clarify the scope of the report. This particular report focuses on anticipated future needs which are not currently identified in other NRC planning documents. For example, in the Office of Nuclear Regulatory Research, we have operating plan. An operating plan is really the master document that lay out all the plan work. And we have research ongoing in a lot of different technical areas such as human factors, fire, instrumentation and control, thermal hydraulics, severe accident, materials, PRA, neutronics, radiation protection, environmental assessment, structural, nuclear fuel and security.

And research plans currently exist for certain topic area research program. A separate research plan do not exist for all the technical areas that research is currently performing work. Most of our planning documents also focus on current near-term regulatory needs rather than over the horizon or forward looking from like five, 10 or 15 years from now, so we have set out now to duplicate the information that's currently in other planning documents in the agency and really focus on areas where there would be -- there will be possible work from five -- looking at five, 10 or 15 years from now the agency might need and that we should start looking into those today.

And the information generated by interacting with the other program offices and also soliciting input from research staff internally at this point in time, and that's why I indicated that we're in the process of, for example, coming in front of the ACRS and we'll also be going in front of the ACNW to solicit your input and recommendations and also we will be soliciting input from the external stakeholders such as industry and the National Labs and universities and also international partners.

Here are a couple of considerations that when we set out to do these particular projects, what we had in mind. The plan development schedule needs to support the FY 2009 budget formulation. As Brian indicated we want to put a planning wedge in our FY'09 budget, so the time lines to make sure that we will produce some input on a timely basis to at least get some ideas and some detail information into the budget preparation process.

With this initial effort, we are mapping out a process where we are developing the initial version and that includes who we should be talking to, what time line and what we can do with the information that we receive and whether that can be incorporated into the FY `09 version or it can be -- or it's more appropriate to be considered in the future updates. Also we're keeping this as a living document and the topic areas and focus within the areas can be changed as new information becomes available so it's a very dynamic process. And also this document where we identify new and different ideas, and once a particular idea become mature enough, it will be incorporated into other agency documents or there will be research plan by itself so that it will continue, there will continue to be a list of areas that will be potentially worth exploring and it's different and the maturity level does not warrant a separate document at this particular point in time.

And during the process when we were developing this particular version of the report, one is we are on a pretty quick turnaround time and in the past couple years we have not been in a mode thinking about what the agency might be needing five, 10, or 15 years from now. So we have gotten -- even though we have gotten a fair amount of input, a lot of input really focus on current and near-term needs rather than really looking at -- really looking at five years and beyond. So we need to get people to start getting into a mode of looking at what are really the future that this agency may be facing.

And also there are people who are kind on the sidelines because they are not quite sure whether this is really going to be a fruitful endeavor. So the success of our current -- our current effort is going to be very indicative to the others regarding how the process works, how serious the agency is in taking -- is really thinking about funding forward looking research. And if there are positive outcomes coming out from this particular initial effort, we believe that it will stimulate further participation from both the staff and also other program offices.

The next two slides give you the topical areas that we have identified that's currently in this version of the report and they are divided into two big program areas and the test facility and also cross-cutting and emerging technologies that really cuts across a number of different research areas within the agency. And you see that some, it might not be as clear from the presentation, but if you look at your handout, there are five topics that are involved and those are the ones we plan to discuss with you in more detail this afternoon.

With that said, in the slide package, you do have the material that describe each of these topics in a little bit more detail and they are being presented in the sequence that they are in the current version of the report. As Dr. Powers indicated we will be able to -- we are available to answer any questions even though they may not be within one of the five topical areas that we're going to discuss with you further.

The two big program areas are the DOE Global Nuclear Energy Partnership and the Plan --

MEMBER APOSTOLAKIS: Can we go back to the previous slide? Is that the previous slide?

MEMBER CORRADINI: I think you want the first of the proposed activities?

MEMBER APOSTOLAKIS: Yeah. That's not the previous slide. I'll wait. Number 6.

MEMBER CORRADINI: The next slide.

MEMBER APOSTOLAKIS: That's the next slide?

MEMBER CORRADINI: I think so.

MEMBER APOSTOLAKIS: I'll wait until you're done then.

MS. LUI: Okay.

MEMBER POWERS: George, my instruction for you is to follow the presentation.

MEMBER APOSTOLAKIS: I'm looking ahead. I'm looking at five, 10, 15 years from now.

(Laughter)

MEMBER POWERS: The answer is, no, George.

MEMBER APOSTOLAKIS: I just wanted to provide experiential evidence that Brian was right earlier.

MR. SHERON: Much more mellow after lunch?

(Laughter)

MS. LUI: Okay, so coming back to where I was, the two big program areas that we're looking at are the DOE Global Nuclear Energy Partnership because we have that indication from DOE that whether they are going to be seeking an NRC license or not, the facility that they're going to build, if they are going to go through with this particular initiative, they should be NRC-licensable.

And the next big program area is Reactor License Renewal beyond 60 years. That's based on recent interaction with DOE and industry pointed that there is interest in that particular big program area. The next category are the test facilities that we have looked at and they include -- in this particular category we have two particular proposals that have been put on the table. One is the integrated digitalizing of machine to base research facility. The next one is the integral test facility for non-light water reactors.

The next big categories include, as I have said before, cross-cutting and emerging technologies. In this particular big group we are in a lot of cases are going to be doing scoping analysis looking at where is the state of the art and where the -- where the future direction might be and the likelihood of certain technologies being employed by nuclear industry so that we will get ourselves in the position where we have the technical basis and the analytical tools to do the necessary confirmatory review.

And that includes advanced analytical capabilities, Slide Number 6, advanced application technique and the best sensor technique to monitor the plant standards or the site standards, offsite mitigation, strategy, a general area of nanotechnology, fire modeling and risk assessment for advanced reactor and fuel cycle facilities and the last category, formal decision analysis and methods. And with that, I would stop at this point before we go into the five highlighted areas for a more detailed discussion and I can entertain questions at this point.

MEMBER APOSTOLAKIS: Why did you choose those areas for discussion?

MEMBER CORRADINI: It's the subcommittee's fault. We said they could never go through all of these today, so we suggested to pick a few illustrative points.

MS. LUI: Yeah, we tried --

MEMBER APOSTOLAKIS: Why do you think there is a need for HRA methods for advanced facilities?

MS. LUI: I guess we start off with questions.

MR. SIU: Yes, this was a topic where it was recognized that the general framework for performing HRA, we believe, is generally enough to handle HRA for a wide variety of conditions, but when you start applying these methods, whatever methods you're using to different facilities with different characteristics, then you start -- you have to look and see whether those methods actually apply with the underlying assumptions for the typical applications you're making are appropriate for the new situation.

So if you're talking about new human

machine interfaces, if you're talking about new processes or kinds of actions. Recovery actions can be very different across these facilities. So it wasn't to say that we would develop methods. Again, as Chris indicated, there's a lot of scoping studies here. We would be looking at the methods that we have available, looking at the issues that arise associated with new facilities and see if developments are needed, that was the essence of the proposal.

MEMBER APOSTOLAKIS: Well, I guess the way I look at this is, you know, you want to have some capability to anticipate the issues not in the very near future. If the issue arises and you have say a gas-cooled reactor has different kind of requirements, it will probably be handled when the situation arises.

I mean, it's not something it seems to me that you have to worry about as a long-term issue. In other words, I'm bringing up the criterion of --

MR. SIU: Understood, yeah.

MEMBER APOSTOLAKIS: -- whether something enhances the capability of the staff in general, in disciplines versus things that, yeah, they may happen three years from now but if they happen, we'll take action. There will be an NRR request or something so I don't have to worry about it now.

MR. SIU: It's possible that could happen. I guess looking at the history of how long it's taken sometimes to address issues in this area, it's obviously a challenging area, you well know.

MEMBER APOSTOLAKIS: I mean, you're going to prioritize these at some point.

MR. SIU: Yeah, there's going to be a prioritization but, yeah, this was put in partly because we recognize sometimes it takes a long time to address HRA and some of the more challenging PRA issues. So if we waited until the point where we have a design document we have to pass judgment on and then we say, "Oh, my goodness, the tools we use aren't good enough", that may be too late.

MEMBER APOSTOLAKIS: Advanced quantitative risk methods, what exactly --

MR. SIU: We'll talk to that.

MEMBER APOSTOLAKIS: Yeah, we'll talk to that. Now, how many decisions does the Agency make every day, quite a few? Shouldn't this formal decision thing be a high priority?

MR. SIU: Well, it's on the list. We just, again, for purpose of discussion today, we were going to limit our discussion, but it's in the report. We have view graphs and will be happy to talk to that.

Maybe after we finish the other ones first.

MEMBER APOSTOLAKIS: And our of curiosity, why do you care about advanced fabrication techniques? What is the regulatory impact of that?

MR. HELTON: I think that's another one we're going to highlight today, so --

MEMBER APOSTOLAKIS: But can you tell me why you care?

MEMBER POWERS: Why don't you wait till they get to the presentation?

MEMBER APOSTOLAKIS: All right.

DR. BANERJEE: I want to ask a more general question. I understand the motivation, I don't know what the Commission or the Chairman wanted but what is your motivation, Brian, Chris, behind this? Do you see -- let me say what's in my mind -- that you want to maintain a certain level of expertise and science going on in areas that potentially might be of importance, so you can react whatever the requirement is, because very rarely is research going to be done that will ever be directly applicable to something in the long-term?

So is it capability you're trying to maintain? What is it you're trying to do actually?

MR. SHERON: What we're trying to do is

anticipate where the industry may be heading in certain areas. For example, digital I&C, Jack Grobe has a task force going on right now and they're scrambling to try and come up with criteria that the industry can use because what we had in place the industry did not want to follow for whatever reason and we were not prepared to be able to sign off and say whether or not what they were proposing was adequate or not.

The industry really hasn't provided you know, enough -- now you can argue and say, "Well, the industry needs to justify", okay, but we need to get ahead of the curve, okay? Material degradation is another one. You know the years I spent in NRR was always playing catch-up. Every day you came in you found some -- you know, it was almost scary. You know, what are they going to find today, type of deal, as opposed to trying to get out ahead and say, you know, where can I expect to find failures, okay?

As I said, you know, we're trying to do like Inconel 690 and do accelerated aging and find out is this stuff going to crack down the road? You know, the industry is putting it in, they're telling us it's, you know, the big savior. You know, it's a tough material. We don't know where we're going to be

30 years from now. It's stuff like that, trying to say, "Where do I have to be". Control rooms, digital control rooms, if you see some of these pictures of where control rooms are going to go, you know, from these panels with annunciators and switches and all this stuff to a screen.

You know, and the question is, you know, what are the failure modes that we have to worry about, okay. As Nathan was saying, what's the human -- you know, the human performance element in there? How do they respond, how do operators respond. So these are things that we see coming -- or we think we're going to see coming down the road and what we want to do is get the agency position so we're not playing catch-up.

In other words, when the industry shows up with it, we want to be ahead of the game, we want to at least be where we have knowledge of what they're proposing, that we've done some work in the area, that we may have guidance out there, you know, as opposed to going, "Oh, my goodness, we've got to go learn about this and make it up on the fly".

DR. BANERJEE: Right, but my point was -- sure that can be one motivation but at the deepest level, you're trying to maintain your expertise so that some unexpected thing comes along, not so unexpected, say like sumps being blocked or something, that you have the capability to react to it so that you know, today, for example, we can't calculate how much of the suspension drops out on the way to the screen or something. But if you had the capability in this sort of area, you could react fairly quickly and be able to deal with that issue and help in the confirmatory analysis that comes along.

MR. SHERON: Well, yeah, but the point is, has the industry even proposed --

DR. BANERJEE: They haven't.

MR. SHERON: No, yeah, and I would -- you know, and I'm not trying to point fingers to NRR but I'm saying is that if the regulator doesn't need the information in order to make a safety decision, okay, I don't see why we have to go off and develop a complete external program to --

DR. BANERJEE: Yeah, but that's shock them.

MR. SHERON: Yeah.

DR. BANERJEE: I'm talking of something where you choose disciplinary areas which potentially have impact in the long term. There could be some representative cases in each where you can see potential applications but about 50 percent of the time you're not going to really foresee what's going to happen. So you have to just have the capability, Panzer troops to go where they're needed, but you need that tanks. You know, without them you're done.

So if you're like holding the Maginot Line or something, it's -- yeah.

MR. SHERON: Yeah, I mean, the other things we're trying to and I emphasize that, you know, we do confirmatory research. It's not our job to solve the industry's problems. You know part of it is to just look and see where are there potential problems, right, and to identify those early on to the industry, so the industry can start to take action. If they know where the NRC is going to have difficulties and problems and if we can articulate those clearly early on, then they can start and put in place the appropriate research or development programs that they need to provide the information to the NRC when the time comes.

So to me that's another aspect of this work we're doing. It's not necessarily to solve industry's problems, but to just identify where are there potential problems in these areas that are being talked about, where are the hard spots that we're liable to have difficulty with, okay. And then we can engage with the industry and say, "These are areas you're going to have to address if and when you come in with this, you know, five years or 10 years down the road".

We may decide to do our own confirmatory research just to learn about it more, okay, but the expectation is that the industry would be still responsible for developing the technology.

DR. BANERJEE: Sure, of course. Because I'm really looking for motivation but maybe --

MEMBER APOSTOLAKIS: Let's take an example of what happened recently and see if you had this five years ago what your response would have been. I think it was Clinton that came in for an early site permit and they had their new seismic analysis. Is that Clinton?

MR. SHERON: Yeah.

MEMBER APOSTOLAKIS: And that seismic analysis was new to the staff. It was done by some distinguished people from the industry side and my understanding is that eventually the NRC asked the utility to go back and do a traditional analysis if they wanted an answer any time soon, correct? That's what the Chairman told me Monday.

MR. SHERON: Yes.

MEMBER APOSTOLAKIS: What would have been different if you had done this five years ago? Would you have been ready to review something like this quickly and not be surprised or -- I mean, how would things be different? That was a new methodology for dealing with an issue that we know is there.

MR. SHERON: Well, if we knew that the industry, for example, was developing a new methodology -- in other words, a lot of this has to be corroborative, okay. In other words, I can't foresee what the industry is going to do if we don't know where they're coming from, okay?

I mean, I would expect that if the industry had a new methodology that they were working on, one of the things we'd like to know is, "What are you working on". You know, I would ask EPRI. "What are the things you want, do you think you're going to be coming in with in the next five years"? Okay, they're doing a lot of work in NDE, underwater welding, stuff like that, okay. I'd like to understand, you know, is there going to be a proposal coming in five years down to road, okay, or do you expect one.

If they can give us that information, you know, just like a seismic analysis method, okay, then, yes, we can say, "Yes, we need to start and learn about that". We need to understand it. We need to do our own work. We need to be prepared so when they come in, we don't sit there and say it's going to take us three years to review this, to understand it and review it and the like", and you know, "If you really want something in the sort term, you're going to have to go back and do it the conventional way".

MEMBER APOSTOLAKIS: But you don't know now that the industry is working on these issues here, right? No, you're just developing a list based on what your --

MR. SHERON: Well, this is the anticipation.

MEMBER APOSTOLAKIS: Yeah.

MR. SHERON: And like I think I said yesterday is that as we look through these issues during our first cut, we may find out that there's nothing there. We may conclude, for example, on fiber optics, you know, if the industry isn't going to move towards fiber optics, then we may say, "There's really no need to do any work on fire modeling at this time".

MR. SEXTON: I suspect this comes down to maintaining really expertise, cutting edge expertise in certain key areas, so you will have the flexibility to move into you know, these new projects and new developments easy and handle them very quickly. In my mind, it comes down to this issue we've discussed in the past about core competencies and how to do it.

MR. SHERON: Well, I think it's a little more than that?

MEMBER APOSTOLAKIS: Huh?

MR. SHERON: It's a little more than that.

MEMBER APOSTOLAKIS: I'm sure it is.

MR. SHERON: We're trying to look a little bit beyond the horizon, you know, and right now, I don't think we're really pushing that, okay, but the idea is to push that a little bit more and to see what's coming down the road and to say, "What do we need to do? Is there anything we should be doing to prepare ourselves"? That's all.

MR. SIU: If I may, George, just a point of clarification; in most of these areas actually we do have a good idea where industry is going. We've been in communication with them. Many of these topics you'll see in the discussion. There is an industry element to the proposal. So hopefully we're not just guessing where things are heading.

MEMBER ARMIJO: Can this problem be

approached from a disciplinary perspective rather than from an application perspective?

MEMBER APOSTOLAKIS: That's where I was going.

DR. BANERJEE: Or a matrix perspective.

MR. SHERON: Sure.

MEMBER APOSTOLAKIS: Ultimately what matters is the disciplines.

MR. SIU: Yeah, actually, what you're seeing, the product, the initial version did start from a discipline viewpoint. It got narrowed down to a relatively small group and so it was organized in this particular way but the points about the matrix we've heard yesterday for example, as a presentation tool, is something that I think we could use. But actually, there was an effort to identify disciplines and activities in the different disciplinary areas and Chris actually mentioned some of these in her opening remarks today.

MEMBER ARMIJO: Wouldn't that be much more valuable in terms of, you know, long-term impact of whatever you're doing? You're essentially developing and maintaining expertise in specific disciplinary areas?

MEMBER APOSTOLAKIS: I see it as a

complication of things. It seems to my by doing this you are also identifying the disciplines where you need to have expertise, so it's a back and forth.

MS. LUI: Correct. I mean, there are -- I mean, yesterday during our discussion with the subcommittee, we did talk about organization of information is challenge because on one hand, we want to do that, because seldom we're dealing with a particular issue that only involves on discipline. So it's always multi-discipline involvement. And so we're looking at the bottom line, what particular issue that we're really trying to resolve and look at what technical expertise that we need and then we can go down to a level of detail where, okay, what particular discipline needs to focus on what.

So in this particular case, we have chosen a mixture presentation and one is a reflection of the status of integration among the various technical issues and also -- it's also a reflection of the awareness that the various technical discipline does exist and we need to maintain the field capability and the tools in order to analyze the situation that we believe we may be facing in five years or beyond.

DR. BANERJEE: Chris, what would be helpful, I think at least to me, I don't know about others, would have been if let's say on one side you have the projects, on the other side you have the disciplines, yeah, more or less like that, so that we understand which are the areas which are most in demand. So imagine that you take any one of these project, say fire modeling or something, so this involves that you have understanding of chemistry, fluid mechanics, you know, some materials problems, so maybe two or three areas are identified.

And then for something else you may have probabilistic, whatever that field is called, I'm not sure but, you know, you have a number of areas. So in the end, you end up using these disciplines for each of these projects. You're really identifying a set of core disciplines which you need to have competence in.

Say the vibrations which break of these seam dryers, you need to have materials, fluid dynamics, acousics whatever.

MEMBER WALLIS: Are these competencies within the agency or a subcontractor? Are you going to subcontract some of this stuff?

MEMBER CORRADINI: It would be a combination of both. It was just like when we were talking about yesterday that they would have certain --

MEMBER WALLIS: I think what Sanjoy was talking about, there seems to be something unique to have within the agency.

MEMBER CORRADINI: But they would probably be --

DR. BANERJEE: They have to manage this.

MEMBER WALLIS: You could always buy something outside.

MEMBER POWERS: Well, there are cases where you cannot and we have spoken to that many times in our report. I think at this point, it's somewhat useful for them to go ahead and go through their examples and we can come back to the philosophical approach. Now, what we did at the subcommittee is we spent a little while going through these things and eventually we said, "Okay, fair enough, the staff has taken their approach and we will accept their approach for what it is and comment on that", because we are under the monkey to comment on long-term research ourselves, independently of the staff and we'll do so as part of our research report.

And so in the spirit of diversity and response perhaps makes the chairman happier, I think the staff should go ahead and present their look at the elephant here and some examples of their look.

MS. LUI: Okay, so the very first example that we have chosen to present and discuss in more detail today is the license renewal beyond 60 years and that would be Slide Number 10 in your package.

MR. TREGONING: I'm Rob Tregoning from the Office of Research and I'm going to be talking about the reactor license renewal beyond 60 years. A little bit of background on this, this was a topic that, again, was kicked around informally within the agency for some time. There's been even some informal discussions with the industry but actually we got some major impetus around December when DOE came to us at a senior management meeting and actually raised this as a topic for potential mutual collaboration.

So at that time it raised it on our radar screen as well as the radar screen of a lot of senior management as something that was starting to look more real. So from that perspective and the fact that this would be a program area, potentially a major program area, in fact it already is. License renewal is a major program area already at the NRC, it was something that --

MEMBER APOSTOLAKIS: What is, going beyond 60 years? Is that what you're calling major? Did I miss something?

MR. TREGONING: We have license renewal now that takes it up to 6- years.

MEMBER APOSTOLAKIS: License renewal, yes.

MR. TREGONING: This is talking about beyond 60 years. So the objective of this work would be to evaluate and update as necessary, the technical basis for supporting the evaluation of possible requests for license renewal beyond 60 years. Some of the background we know to support the first round of license renewal which we're currently really in the midst of now, many of the plants have made very significant modifications to their safety-related SSCs or System Structures and Components. So that in and of itself, does provide some impetus or impetus for license renewal.

There are two regulatory statutes which govern license renewal, 10 CFR 54 governs the safety issues and 10 CFR 51 the environmental issues. There are no regulatory limits in either of those which preclude renewal or extension beyond 60 years. So there's no regulatory impediment to it currently at all. And I mention this informal DOE inquiry that we got back in December about possible collaboration. Now, since that time, we've actually -- we've had a meeting with DOE in the spring where we discussed a path forward.

Gene Carpenter is here and he's actually the staff POC on this issue and what they've decided at least in the near-term is DOE is going to be meeting with the industry in the spring of this year. They're going to be gauging intent as well as evaluating some of the potential technical and regulatory hurdles that exist and then after that, there's going to be a determination and a working group formed between DOE and NRC on proceeding jointly with resolving some of the issues that are raised. There's also a workshop scheduled for June where some of the various aging issues are going to be raised.

And I think I mentioned the statutory things that governed the license renewal. In terms of technical basis, there's two prime reports. There's the GALL report and the GEIS report and I know the committee is familiar with both of those. GALL is the Generic Agings Lessons Learned report. It governs the maintenance programs and the management of aging that the licensees have to demonstrate in their renewal applications their upholding.

And then the GEIS, the Generic Environmental Impact Statement, there are supplementals to the GEIS report for every plant that comes in that has their Environmental Impact Statement. Next slide, please. So the uses of the research would be to support modifications to the GALL and GEIS documents as needed so that we have a technical basis for extending the licenses beyond 60 years. And there might be some necessary compensatory changes to related SRPs and reg guides to support that but again the main focus is going to be at least initially on the information that's in the GALL and GEIS documents.

MEMBER WALLIS: These were subcontracted, weren't they?

MR. TREGONING: I'm sorry?

MEMBER WALLIS: GALL was subcontracted out?

MR. TREGONING: You know, I was not here when GALL was done. I mean, there were aspects of GALL that were certainly subcontracted out. I don't know that the whole -- and Bill might be able to answer. I -- the whole report wasn't subcontracted out, was it?

MEMBER WALLIS: The whole thing was.

CHAIRMAN SHACK: Well, large chunks of it were but, I mean, it was subcontracted, but it was a very close interaction between staff and --

MR. TREGONING: Yeah.

MEMBER POWERS: Yeah, I would say that it was much more of a staff product than a --

MR. TREGONING: The final product was, yes, it was an accumulation of many of these sub-projects.

MEMBER POWERS: It was an accumulation. Thee are others that I would say, you know, was a contractor product, but this I recall was a staff product.

CHAIRMAN SHACK: Well, even piece by piece, it varied in the level of which was done by the contractor and which was done by us, but overall the whole thing got -- I mean, it is an agency product when you're all done because you know, the first draft doesn't look anything like the current one.

MEMBER APOSTOLAKIS: But some of these subcontractors are really an extension of the staff. I mean, that's essentially what happens. They are working with the staff for years.

DR. BANERJEE: You mean the National Labs.

MEMBER APOSTOLAKIS: Yeah, yeah, the universities don't have that fortune.

DR. BANERJEE: We've got misfortune.

MR. TREGONING: GALL itself is NUREG-1801. So by that definition, it's a staff product.

DR. BANERJEE: Let me ask you, Rob, are there really some fundamental issues that have to be resolved in order to get to this 60 years, beyond 60 years, something fundamental about materials or some understanding that we need?

MR. TREGONING: Well, there's nothing fundamental that happens at 60 years plus one day.

DR. BANERJEE: No, but I'm talking about qualitative changes, something happens?

MR. TREGONING: No, there's no -- you know, aging of materials and other components is much like aging of biological systems in that, you know, it goes on and it can go on under the surface and then, you know, things happen.

DR. BANERJEE: Hard to live beyond 100 years though, correct?

MR. TREGONING: Well, but --

MEMBER APOSTOLAKIS: The real question is in this sub-bullet where it says, "Conduct scoping study", I guess Sanjoy is trying to anticipate what the study result --

DR. BANERJEE: I understand, you know, there are some really exciting things.

MEMBER APOSTOLAKIS: Will there be -- I mean, it's conceivable that after you do the scoping study, you decide that the expertise basically exists, so you don't need a research program.

MR. TREGONING: That's true.

MEMBER APOSTOLAKIS: Because everything else like updating the SRP and so on, that can be done when they issue a license.

DR. BANERJEE: So why did you select to present this?

MR. TREGONING: There are some potential things out there for -- we know -- and again, I wouldn't call these new but some of the things and some of the decisions that we made for the current round of license renewal, we -- there were conservative design and evaluation assumptions that were still appropriate for 60 years. However, going to 80 years they may not be appropriate and the example I gave yesterday were a lot of the cumulative usage factors for fatigue that have to be assumed in the evaluation of components.

Now, in many cases, we were able to get away with a very conservative analysis and it was okay for 60 years. We may not be able to get away with that same analysis for 80 years. So we'll need some technical basis for demonstrating that at least generically a slightly less conservative evaluation would still be acceptable. So that's one example.

MEMBER APOSTOLAKIS: Assume now that you find that from the scientific point of view there aren't really any major challenges, but there will be a lot of work updating the SRP, the goal and so on and so on. If the agency decides to do that, which of course, at some point it would have to, I hope that that effort will not be part of this long-term research.

MR. TREGONING: No, this is --

MEMBER APOSTOLAKIS: It would have to be moved somewhere else as an agency need. Unless there is a real technical issue here, this should not get any resources.

DR. BANERJEE: Yeah, well, I was thinking of his example of the human aging, well, obviously, people are looking at the mechanisms which govern, you know, the cell life cycle. There would be fundamental issues there which lead you to understand why a cell dies, why it lives, why it regenerates, the genetic code that makes it happen and stuff like that. Are there issues like that here that are required to be elucidated or are there not?

MR. TREGONING: Yeah, and maybe I'll want to stop with the biological analysis. Maybe that wasn't a good analogy because that's a much more complicated. Usually your analogies are supposed to be simplifying analogies. I would say in that case I probably erred but we certainly know that, again, with many of these mechanisms -- we certainly know with many of the corrosion mechanisms that they're driven by, you know, usually three components; time, stress and environment, right.

And we have a pretty good understanding of many of these mechanisms as to what thresholds are. However, we've been surprised quite often. PWSCC is a good example in that you know, most of our -- you know, PWSCC we have a lot of good laboratory data talking about the temperature sensitivity of PWSCC which is largely true. However, that doesn't mean that lower temperature environments can't also lead to that same sort of degradation.

And we've actually started seeing those in some cases sooner than we may have anticipated. So, you know, we have a lot of knowledge in this areas. We're continuing to accumulate knowledge.

DR. BANERJEE: Rob, I was giving you a lead-in. You should have said we need meso-scale and

MD simulations to better understand what's going on.

MR. TREGONING: You know, I'm an engineering first. I think we can do things -- I think we're developing a basis for this but I still think we need to evaluate what additional work, if any, maybe required.

MEMBER MAYNARD: I do think this --

MEMBER POWERS: If we have any hope of getting through five, you might want to move on. You're being way too slow.

MS. LUI: Okay.

MEMBER APOSTOLAKIS: Otto.

MEMBER MAYNARD: I do think this is an important one because I think it's real because it's something that is going to be needed. I think the scoping will be able to narrow it down to where it's not going to require a major effort but I think in a couple of areas there is going to be a need to focus some effort, reactor vessel, mostly it's going to be materials issues, I believe, because we -- material doesn't approve with age, so you know, it's how much conservatism do you continue taking on.

So I think it's a good one. I think it can be narrowed down.

DR. BANERJEE: So biologically, we

improve.

MR. TREGONING: Okay, just one final; we've identified three areas, materials aging, electrical aging and then environmental and rad protection. Those are the three primary areas that we'll be evaluating.

MS. LUI: Okay, the next topical area starts on page number 14. And I just wanted to add, while we're getting there, I just wanted to add one more comment that, because we are always planning for two years out of all occurrences, so we have to go with the best available information to us at this point in time and to project out two years from now what kind of resource you might need. So it's not cast in stone that that's exactly what we're going to be doing and that's exactly the amount of resources we're going to need. We always have opportunity to come back and reprioritize but at the same time, what we are providing to you right now is the best information we have available and it's a very dynamic process. So we can always change based on new information.

MEMBER APOSTOLAKIS: But this seems to me -- I must be missing something. You're talking about facilities here.

MS. LUI: Correct.

MEMBER APOSTOLAKIS: So what exactly can you do anticipating what's going to happen --

MEMBER POWERS: George, to be honest with you, maybe you ought to let them go through it before you ask the question because I think they'll clarify it.

MR. HELTON: Actually, I'd say why don't we treat that as the perfect segue into integral effect test facilities. My name is Don Helton and I'm from the Office of Nuclear Regulatory Research and I'll attempt to answer that question and if I don't then let me know and we'll continue to visit that point. This effort is geared at looking at the facilities that are our there and available for doing large integral testing associated with advanced non-LWRs. Those could be HTDRs, LMRs what have you. The purpose for doing this would be to insure the adequacy of the safety criteria that we're using to license these facilities, to insure that we understand and are comfortable with the tools the licensees are using as the basis for licensing the facilities and to validate our own tools for doing confirmatory analysis.

What we would focus on in fiscal year 2009 is the availability of those facilities, identifying what facilities are out there and what they can be used for and then also identifying what needs we have in terms of testing, in terms of confirmatory testing to get at those needs that I've just discussed. So this is not, on the surface, us setting out to build facilities. Obviously, the first cut here is to find the facilities that already exist to, as much as possible, leverage opportunities with folks like DOE. This came up in the subcommittee.

We are interacting with DOE on this issue on a number of fronts but the most recently in terms of the PIRTs that we are doing right now. And like I said, to separately identify the needs that we have and try to mesh those.

DR. BANERJEE: Don, but don't you have a pretty good idea of what already exists so you don't have to task this? I would have thought you would have a pretty good idea of what exists, what facilities there are.

MR. HELTON: Well, we certainly have some level of understanding of that. We're certainly developing that as we go now with our advanced reactor research. That's part of the reason that the word "scoping" appears here. And like I said, the second or the other aspect of this is not only knowing what's out there but knowing what our needs are and if I can over -- possibly over-step my bounds a little further, it's -- you've got to know the facilities that are out there but then you've also got to look at them enough in terms of your needs to understand their limitations and what modifications might be needed to get at an aspect that's slightly different than what they were designed to -- fit what they were originally designed for.

DR. BANERJEE: So you're talking of maybe adaption or some joint programs in terms of that. You're trying to develop this. These are long-term items.

MR. HELTON: Correct, they are.

MEMBER POWERS: I might just interject here that I recently completed an examination of a French nuclear facility for gas reactor testing and you find a facility that looks very good for this purpose. The lead time for the necessary modifications, it won't be on line till some time after 2011. And then you discover that the core life limits the amount of testing you can do. So you can't sit down and plan 100 tests. You have about 10, just because of the core life.

DR. BANERJEE: When is this going to

appear? When can we see this?

MR. HELTON: The results of this?

DR. BANERJEE: The scoping and the --

MR. RUBIN: Maybe I can help out here a little bit. I'm Stu Rubin, Senior Technical Advisor for Advanced Reactors in the Office of Research. And I would kind of mention that this is one area that we're fortunate in that the agency has an outreach program to industry and others and that's the Advanced Reactor Policy Statement. And the Advanced Reactor Policy Statement encourages designers and developers to come in early on with their ideas for new designs, new technologies and the like and new methods for licensing well in advance of making an application and for that reason we know a lot about what are the specific plans, if you will, for technology use and new kinds of designs. So this may be unique in terms of having -- an agency having an outreach to get that kind of long-lead technology interests identified.

As far as the facilities themselves are concerned, I think you're right, in terms of knowing what's out there, DOE has a good handle on that. We have a good handle on that. The industry has a good handle on that and we're all basically looking at those same facilities and the adequacy of those facilities to cover the gamut of technical arenas and disciplines. So if you did your matrix, I think we would pretty much touch on fuels, materials, thermal fluids, fission product transport and things like the sub-disciplines for all of those.

So we're looking at the availability of facilities to things like develop and benchmark our codes. One area that jumps out for example, is fission product transport modeling and the availability of separate effects and integral facilities for that. I'm not sure that there's much out there right now in that area and there's going to be a need, I think, on the part of the applicants and DOE to come up with some separate effects and integral facilities to get a handle on that because it is vital in terms of the licensing approach that the gas reactors are using which is to have a mechanistic source term and release calculation so they're going to have to get their handle on that, and there will be needs for facilities and we're going to help DOE and the applicants figure that out.

Now, as Brian pointed out, the primary responsibility is the applicant to provide the technical basis for the modeling.

DR. BANERJEE: The first applicant will be

DOE, right, in the sense that they'll build the first one.

MR. RUBIN: Well, I think we are looking at DOE and saying, "Hey, you know, if you want to come in for an application or support another applicant for the NGNP very high temperature reactor, we expect that you're going to come in with a sufficient technical R&D basis for the models, the data to support the models for your safety analysis. Now, we may want to -- well, we will want to develop our own independent models and take advantage of that data and may question the adequacy of some of that data and may choose to use those same facilities for some other kinds of testing to either validate or invalidate our concerns.

But in answer to your question, I think we know what those facilities are. I think we can anticipate we're going to use some of those facilities or at least expect the applicant will and we may, in fact, when we look at the gap analysis of what is needed versus what's available, insure that those facilities are available, because if they're not available, then I think we may have --

DR. BANERJEE: I think this is a good item because there's a very long lead time.

MR. RUBIN: Absolutely. Yeah, a lot of these tests take five and six year to run.

DR. BANERJEE: Right, so if you can anticipate something that's --

MR. RUBIN: Sure. And by the way, the Advanced Reactor Research Plan starts that process of thinking about that, what those kinds of gaps are and what facilities may be needed, maybe not by name but identifying where we think those gaps are.

DR. BANERJEE: In parallel probably, you also need to take a look at what instrumentation and measurement systems, because often when we've gone in with the big facility, we've had to develop instrumentation for it in parallel, not that we can actually instrument it -- especially in reactors.

MR. RUBIN: Yeah, and I think in some of these plants, we expect the first of a kind to be instrumented even more than the commercial version of the plant and I --

DR. BANERJEE: Yeah, that's in a pebble bed, how do you find the temperature within the --

MR. RUBIN: Absolutely, if you look at the HGTRs there's no in-core instrumentation to speak of. But yet, we want to have some sort of bench marking of what temperatures may be within the core and there are techniques available to do that. And I do believe that the designers are looking at those kinds of special instruments to help collect that they really need to get a good handle on the parameters to do the bench marking of the codes, et cetera.

Now, what's needed for the commercial plants, there will be that as well.

MEMBER ARMIJO: The big problem I have with this activity is that it's limited to non-LWRs. I think the test facility is available to support the huge light water reactor fleet plus the new light water reactors that the US has, that infrastructure has atrophied dramatically. Hot cells are in pitiful state, certainly not a test reactor in the United States that for advanced fuel cell. If this task could be expanded working with DOE, I think NRC would do the nation a service by identifying how poor a state we have to support the main fleet.

MEMBER POWERS: I wonder how many times it has to be identified. I mean --

MEMBER ARMIJO: Well, somebody's got to come up with some money and somebody take the lead.

MEMBER POWERS: They have -- I mean, CSNI conducted a major effort, went out and published reports, said, "Oh, my God, these things are decaying.

We don't have any hot cells. We don't have any test reactors and whatnot?

MEMBER POWERS: When was that?

MEMBER ARMIJO: It was about three years ago, four years ago. Maybe you know better than I do.

MS. LUI: No, actually there is a report that just came out recently. There is a new study that came out that has highlighted all the facilities and their capabilities and they estimate how much it would cost to rebuild these type of facilities. So that information is pretty recent. We have --

MEMBER ARMIJO: I'd like to get a copy of that.

MEMBER POWERS: Just to show you how effective the capitalistic system is, the former Soviet Union came out almost immediately with, "We've got something for every one of these needs".

(Laughter)

DR. BANERJEE: Yes, and the rental was at international rates.

MEMBER ARMIJO: Right, and the time scale for getting problems solved is longer and, you know, there's a lot of things.

MS. LUI: Right, the next topic area starts on page 16.

MR. HELTON: I'll be covering this one as well. This is a topic on multi-phased computational fluid dynamics. This agency currently has an in-house capability in the area of single-phase --

DR. BANERJEE: I would dispute that.

MR. HELTON: As one of its practitioners, I'll take a little offense at that but not much. We have apparently debatable in-house capabilities.

DR. BANERJEE: Let me put it this way, Don, when you can do the calculations for the vibrations and acoustic waves with the steam dryers, I'll buy that.

MR. HELTON: That is one application that certainly challenges pretty much anyone trying to practice CFD. As you know, trying to run LES and that type of geometry to get out acoustic functions is not an easy task and our in-house capability would currently not support that.

MEMBER KRESS: Just the fact that he knows that is a good sign.

MR. HELTON: So it's that single-phase capability that we would like to extend to multi-phase. We are starting to see applications internationally as well as domestically in the nuclear industry building off of the use of multi-phase CFD in other industries. I list a couple of examples here of where we would use it and I would also extend this to operating reactors as well. There are certainly issues related to operating reactors and new reactors that have two-phase issues and as we talked a little bit about in the sub-committee yesterday, there are also applications in advanced reactors for two-phased or quite often --

DR. BANERJEE: Again, I want to ask you something about this. Now, if you're talking about an average multi-dimensional, multi-phase capability that maybe already has that. Are you able to access that or not? Not, maybe -- it's a smeared approach but there's been a lot of work done at Capital for this.

MR. HELTON: When you say average, you're just referring RANs, the Reynolds Average --

DR. BANERJEE: No, I'm talking about the average multi-fluid model for multi-phase flows. But of course, it doesn't give you anything of interest but nonetheless, it's there.

(All talking at once.)

MR. HELTON: I'd like to thank you for providing us with that one. I'd like to thank you for providing not only the question but the appropriate answer. Since that capability wouldn't really buy you anything, I'm not sure that we --

MEMBER POWERS: I understand life in a university is a bit different.

DR. BANERJEE: This is a long-term view, come on.

MR. HELTON: Certainly, looking at that and other techniques, other capabilities, it's something we would do here. At this point, we're not confining ourselves to a commercial code versus a research code. We're not confining ourselves to a particular approach to the multi-phase modeling. What we'd like to do is look at what's out there, investigate, see what seems to fit our applications the best, build on some recent work that's been done by CSNI working group on two-phase flows at the NRC and others participated in and decide which of these tools is best going to fit our applications.

You mentioned the Navy. We are certainly not going to be in the business of developing multi-phase CFD. There are lots of people already doing that. It will be our intent to take the work that somebody else is doing and apply it to our specific areas of interest. A lot of the development is even in other industries where they're just not worried about the pressures or temperatures that we're concerned about. So it's --

DR. BANERJEE: But NRC used to lead this field. Why can't you lead it again?

MR. HELTON: Used to lead the multi-phase or the CFD in general?

DR. BANERJEE: No, CFD, not multi-phase. Why do you have to follow what the Europeans are doing?

MR. HELTON: We're not necessarily following what the Europeans are doing. I'm --

DR. BANERJEE: The Chairman is giving you an open slate, saying "What is it interesting to do," right?

MR. HELTON: Yeah, not insinuating that we're going to follow what the Europeans are doing, we certainly want to see what they're doing and if it makes sense for us to do that, then that would be a logical path for us to go down, but we'd also like to see what other entities, domestically are doing, what other international groups are doing. And I mean, I don't want to --

DR. BANERJEE: Anyway, I'm saying, think out of the box on this.

MEMBER WALLIS: Isn't RPI doing --

MR. HELTON: I'm sorry, go ahead.

MEMBER WALLIS: Isn't RPI doing something like this already?

MR. HELTON: What's that?

MEMBER WALLIS: Isn't RPI doing something like this already?

DR. BANERJEE: That's the Navy stuff.

MEMBER WALLIS: RPI doing something like this already and aren't you funding some of that?

DR. BANERJEE: No, but they're doing average.

MEMBER WALLIS: Yeah, that's right.

MR. HELTON: We have had a small --

MEMBER WALLIS: It's still CFT, isn't it, it's not the whole channel?

MEMBER POWERS: I'm sure that RPI is not looking at the computational vehicles for doing reactor accident regulatory analysis.

MEMBER WALLIS: They're not?

MR. HELTON: We are -- we have been in the past, involved in a very low level effort in supporting RPI and the Applied Research Lab at Penn State in specific developments for a code called In-Phase that they developed for other users as well, but that has been a fairly low level effort in the past. In-Phase is certainly one of the tools that's out there that we would look at, but --

MEMBER POWERS: Don, just to make sure that you get lots of mixed signals from the committee, I am quite certain that somewhere at some time there was a body like this with people like you sitting in front of them saying, "We've got to look at advanced computational devices or the future in France, in Germany, in Japan, and in Korea. And why wouldn't it be reasonable to do that in concert rather than separately?

MR. HELTON: If I'm not misunderstanding your question, then I think the CS&I working group that met over the past year which was specifically looking at potential problems that the nuclear industry is trying to solve that could benefit from two-phase CFD problems. That's something that we were engaged in and it's a good starting point for at least identifying which are the -- of the wealth of problems that are out there, which could we actually get some immediate benefit from by using this type of --

MEMBER POWERS: It's not the problem that I'm interested so much as suppose I said, yeah, I believe that I do need -- I will in 20 years need some advanced CFD capability and that enlightenment came from me -- say Bland just came in and told me that, why wouldn't I go to my counterpart in France and Japan and South Korea and said, "Let us work together on this," because it's likely to be expensive and you certainly are seeing an internationalizing of the nuclear industry that I don't think is going to get reversed very soon, and so you don't want to get into a situation where you're arguing with your Japanese colleague over whose code is better.

MR. HELTON: We do that in every other discipline. Why would we not do it in --

(All speaking together)

MEMBER POWERS: Well, I'm not sure that that's been a productive expenditure -- it's certainly not been a productive expenditure of ACRS subcommittee meeting time.

MEMBER WALLIS: People in the multi-phase area always argue about things.

MEMBER POWERS: I have noticed that and I'm trying to put an end to that.

MEMBER CORRADINI: It's a religious thing.

MR. HELTON: We certainly want to pay attention to that. Certainly the Neptune project that IRSN is entering into which includes multi-phase CFDs is another example of something that we would like to stay abreast of. At this point, we're not limiting ourselves from doing that.

MEMBER POWERS: I mean, to me the most encouraging you've said is that you're thinking very broadly on this issue and I'm glad to see that, so press forward. Don't let me or anybody else deter you because --

MR. HELTON: I'm not sure I have that luxury.

(All talking together.)

MEMBER POWERS: Appeal to the Chair and we'll get you through this.

MS. LUI: Advanced fabrication techniques starts on slide number 20.

MR. TREGONING: Okay, this one is mine, advanced fabrication techniques on slide 20. I'm debating whether I want to begin at this point. The objective of this one is to evaluate the performance of new construction, fabrication and manufacturing techniques that have been used in other agencies -- other agencies, other industries and then also used abroad for commercial nuclear construction since we've built our last wave of plants 20 years or more ago now and determine which of these new techniques, procedures may be useful for our next wave of nuclear applications and evaluate and assess any technical and/or regulatory issues associated with those.

The other related aspect is we've seen a move away in the industry from prescriptive based specifications both for materials and for construction and fabrication and we want to assess the use and any particular issues related to using performance based specifications.

Now this has been an area that's been of interest to DOE for a long time. Back at the early part, 2001, 2002, they formed at the time was a group, a near-term deployment group they called it, to evaluate issues related to new plant construction and evolving from that was their NP 2010 program which the goal of that was essentially to have a viable nuclear option available by 2010. So as part of that effort, they've commissioned several studies in this area related to advanced fabrication techniques.

One of them which was completed in 2004 by MPR is actually a pretty good starting point for what this work would try to build on but what that work essentially did was it went out and surveyed the industry, and by the industry I mean that broadly in terms of looking at large construction projects, looking at overseas nuclear applications and trying to identify which new technologies are out there which may be applicable for the next wave of nuclear plant construction in our country.

They also talked to the vendors and specifically they queries, you know, ABWR, ESBWR, AP-1000 and then the ACR-700 folks to bounce some ideas or get some ideas from them on what techniques they were considering. And they look at 13 advanced construction techniques and evaluated their maturity and they identified that nine of 12 of those techniques, at least in their opinion, were sufficiently matured to pursue without additional technical issues and then they identified three that there are still technical issues remaining.

So now they're in the point at DOE working with the industry to determine which one of these new techniques are actually going to be in use. If I could quickly go down the list, some of the items that they identified as being mature enough to press forward with, a lot of the things that you might expect, steel plate reinforced concrete structures, which is, of course, prominent in AP1000 and some of the other advanced containment designs, concrete composition technologies, high deposition rate welding, robotic welding, 3D modeling and simulation, GPS applications, open top installations. So these are all very large scale construction related things, pipe bends and then precision blasting.

Now, the three areas that they identified as having technical issues remaining, those come in on a little bit smaller level in some cases and the three areas that they talk about are prefabrication, modularization of pre-assembly issues. Cable splicing was something that raised a lot of -- or is a potential area of interest because, again, that's an area that they think they can get some performance and acceleration impacts. And then the other one was talked about was advanced information management and control.

The other thing with respect to background, much of these techniques are geared toward increasing efficiency, decreasing construction schedules. Some of them offer -- at least advertise performance gains as well. So one of the things we'll be looking at is making sure if those increased efficiencies, if the performance or the safety is still acceptable and adequate and we'll also be evaluating if there's any unique challenges related to nuclear applications. Next slide, please.

The uses of this, of course, this will support our staff review for new nuclear applications.

FY09 activities, we actually plan on initiating some work prior to FY09. The first thing we're going to be doing is picking up and meeting with DOE to see where they're at in their consultation with industry and to identify what techniques industry is looking at promulgating or possibly coming into us with. Some of them we know about as a result of design certification but we don't get all of the details related to construction when we go through design certification, so there are still issues that potentially haven't been identified yet. And then 2007/2008 will be trying to identify technical and regulatory issues. And then in `09, based on what we've learned in `07 and `08, we'll be doing the scoping study to identify what technical issues remain, what may have adverse safety ramifications and from that we'll be able to develop a research plan for addressing and then dispositioning those issues.

MEMBER POWERS: It strikes me as incredibly important to pursue this because these kinds of techniques could dramatically effect how you do the monitoring of construction of these facilities. I mean, it's just going to make -- it's just going to be very different from the way we did it when they built the currently existing plants, could be quite different. And also there are the software tools that are guiding this system that could have an enormous impact on just the constructing monitoring activities.

MR. TREGONING: The other issue that I neglected to raise yesterday is one that we've been dealing with recently but consideration for decommissioning as well, and that was something that initially was not a consideration but as we move forward, it has become a consideration. So deconstruction in some cases, there may be issues associated with that as much as construction.

MEMBER POWERS: I think DOE learned so much in taking apart facilities, particularly -- they said, "We're not going to go through this pain ever again". So when you design a new facility, you have to figure out how to take it apart.

MEMBER ARMIJO: If I may just sort of take a -- sort of a far view of all the items in your plan, I would sort of categorize them into three different categories. One is long-term application-oriented research. And that, for example, would include licensing beyond 60 years or fire effects on fiber optic cable, specific application oriented long-term research for which you anticipate a long-term need.

The second category amongst the items that you have listed is facility needs with long lead times and there are two facilities or facility-types amongst the group of projects that you have listed and the third group is long-term discipline-oriented research, for example, that two-phased CFD modeling or the advanced manufacturing techniques. It would seem to me that if you are in the process of developing sort of a long-term research plan that you are going to update on a continual basis, it would make more sense to sort of categorize the projects in terms of these three categories rather than essentially trying to link them to a specific application.

You have, you know, long-term application oriented, facilities with long lead times and long-term discipline oriented research. This is just an observation that would -- may help you sort of sell this plan and also make it easier to incorporate other projects that will come up in the future.

MEMBER CORRADINI: I had a question about this one. So when MRP did their report in 2004, was part of that report how long some of these new advanced fabrication techniques had been in service to assess the effect of the robustness as aging takes place in some of these structures that are built?

MR. TREGONING: It didn't look so much at aging.

MEMBER CORRADINI: Aging is maybe the wrong word but I'll use the term that -- or the thing that -- in other words, in the nuclear power plants that I've been in and I've been around when they've first been built in the `70s, it was very clear they were over-designed, very clear. On the other hand, there was so much margin that things can last longer -- a lot of these advanced fabrication techniques have cut margin. That's what cut costs. So I'm always wondering, do they know the margin so well they know as time marches on and the structure ages, that they know where they are relative to their fabrication margin. I was curious if the MPR report looked at if there was a technique for making something differently now that was better in terms of its speed or its cost effectiveness, they also looked about how it essentially lasted. Do you see my question?

MR. TREGONING: I think I understand your question and I would -- I might take some contention with the fact that these necessarily will decrease margin. The big focus, obviously, is to improve efficiency while retaining margin to make sure that you have sufficient margin. Some of these things, some of these techniques are quite simply just better and faster.

MEMBER CORRADINI: Sure, I don't disagree. These are engineers. I trust them implicitly but on the other hand, I just was curious since MPR did it, they might have looked at this as one of the key elements of assessing whether something is mature or is kind of settled that it was doable for this sort of application.

MR. TREGONING: When they looked at maturity, they were looking a lot at lessons learned from the construction. Again, they looked at things like construction of the Ted Williams Tunnel, shipbuilding lessons learned, where these fabrication techniques had been applied.

MEMBER CORRADINI: First trick is don't build it in Massachusetts, oh, I'm sorry.

MR. TREGONING: I won't go there. So, you know, they looked at things like how well it was -- how well it was implemented, what problems came up in construction. What sort of -- if they were having defects what sort of things were found. So it was more qualitative than it was a quantitative look at what particular margins were associated with that.

MEMBER CORRADINI: That's fine.

MR. TREGONING: But they did try to

consider, again, those applications and some of the unique nuclear requirements that, you know, that these things would have to demonstrate that they could --

CHAIRMAN SHACK: High deposition rate welding for example, sounds a little scary to a materials guy. I mean, I can understand the speed but the --

MR. TREGONING: That's one that potentially has issues, certainly.

MEMBER ARMIJO: But you know, there's electronic beam welding, laser welding, there's a lot of different things that people can do now and some of it actually would be better.

MR. TREGONING: And again, there might be regimes of applicability in terms of what components, what section sizes, things like that, and those are really all the things that we need to be looking at, you know, and making sure that we're, you know, within the realm that's demonstrated to be technically acceptable.

MS. LUI: Okay, moving to the last technical topic that we have prepared for this afternoon starts on page number 30.

MR. SIU: Are we on negative time?

MEMBER POWERS: We'll give you two

minutes.

MR. SIU: This is a topic and as somebody said, it follows with what we've been pushing on in terms of discipline, in terms of staying up with the state of the art. In fact, the ACRS noted in some specific cases binary decision diagrams that we weren't pursing any activity in that area and asked why. The point of this activity would be to assess some potentially promising quantitative risk assessment methods and determine whether we should be pursing those in greater detail for some of the tools that we have already such as the SAFIRE code.

So under this category we are talking about such things as the binary decision diagrams but other things as well that were not mentioned in previous discussions, the Bayesian belief nets, which is a way of providing cause/effect relationships in a probabilistic manner that can be used to address models that are not limited to statements of failure rates but don't necessarily go to full out simulations of the equipment and going even as far as simulation based risk assessment.

Yesterday, we talked about a Level 2 approach basically hooking MELCOR up to a Monte Carlo driver, very crudely that's the conception. Certainly there are a number of activities we're aware of around the world pursuing the development of dynamic PRA techniques and they seem to have some applicability in Level 2, perhaps even in Level 1 PRA and other places, perhaps even in -- if we start looking at process plants fuel cycle facilities and if we wanted to do a quantitative risk assessment, these might be the kinds of tools that we'd be employing.

So the notion here again, just in nutshell is that we'd be -- we recognize the existence of these techniques. We know that they've developed to some extent. They're not in full blown application mode right now. There are definitely problems as well as potential benefits associated with each of them and we have some awareness of these but we want to do some work, assess where we are, keep track of where things are and maybe at some point decide to go pursue them in greater detail. So that's it in a nutshell.

MEMBER APOSTOLAKIS: Where would you put the need to calculate or to evaluate the unreliability of a passive cooling system? Is it under this quantitative risk assessment method?

MR. SIU: We actually -- I think if there was a quantification aspect, for example, if somebody was saying that they wanted to use a Bayesian belief net approach to that, or a simulation based approach, it would be there. If not, we had another task which we didn't highlight in this presentation talking about empirical data supporting such things as passive system reliability and --

MEMBER APOSTOLAKIS: This would require, I think, some kind of a model.

MR. SIU: Yeah, the other scape, George, is that the Advanced Reactor Research Plan has a PRA element in it and it certainly has been recognized for awhile that we need to deal with passive system reliability. We've made some starts at it. I guess we're not crazy about where we are right now, so work is needed but it wasn't put into this plan partly because of that aspect. I guess part of the point being, if it completely drops off because it doesn't fit in some category, we need to make sure that we have it.

MEMBER APOSTOLAKIS: Oh, yeah, I mean, that's a need.

MR. SIU: Now, the committee is going to be briefed on the Advance Reactor Research Plan at some point, yes?

MS. LUI: Yes, within the next couple of months. We're working on a schedule on that one right now.

MEMBER POWERS: Okay, that completes?

MS. LUI: Yeah, just slide number 32, the last slide, I mean just reiterate what Brian has statement that we have a commitment that we're going to provide the Commission the proposed final FY 09 long term research plan in July so we'd really appreciate your input and your recommendations and I do want to indicate that because we are attempting to develop and agency-wide plan, so to a certain extent we are -- we may not have the full latitude about doing whatever the Office of Nuclear Regulatory Research feels is the right thing to do, because we want to get input from the rest of the agency and Brian's goal is to get at least a no objection from the other program offices. So we certainly welcome your input and recommendation and we welcome that in the process that we are following to develop this agency-wide plan. And we also thank you for you input on how to organize the information to better communicate with the audience that we are targeting at. So thanks.

MEMBER POWERS: They -- what she's saying is that we have to generate a letter and we will and we'll do our level-headed best to get it out to you at this meeting. And other than that we thank you and congratulate you for an awful lot of work starting, I mean, probably ruined your Christmas, New Years and Easter all at once and we'll look forward to hearing more about it as you continue to update. Mr. Chairman, I'll turn it back to you.

CHAIRMAN SHACK: Thank you. We'll take a break up until 3:10 and then come back to discuss our favorite topic, the technology-neutral framework.

(A brief recess was taken.)

CHAIRMAN SHACK: If we could start on. The purpose of today's meeting is to come to some sort of committee position on the technology-neutral framework. We've had a lot of discussion over this. We've had extensive comments from Tom and from Graham. We need to decide where we're going to go. The Staff is preparing a NUREG that they're ready to publish in August. My position sort of is and I've tried to bin these issues that we've all raised into a couple of bins and I put them into what I call technical, policy, and philosophical questions.

The technical questions are those that I think arise whatever choice of top level requirements and risk metrics we choose. Do we want to have LBEs? Do we need a complementary function or can we go on the sequence by sequence that they had? Those seem to me issues that we can decide whether we go -- the Staff has basically used the current regulations and the QHOs to set the safety, the top level requirements for this. Tom has some very different suggestions for how to go.

But whatever set of top level requirements we would pick, we have to decide whether we like the LBE approach, whether we want to add a complementary cumulative function to this and so I think the technical questions we can address without addressing the policy questions.

MEMBER KRESS: I don't agree that your policy issues are policy issues.

CHAIRMAN SHACK: Well, okay, that's a distinction. I guess if only to get through these things in some order, I'd start with the technical questions.

MEMBER KRESS: I don't care what you call them as long as we get to them.

CHAIRMAN SHACK: Again, I think it's probably unreasonable to expect the present NUREG to address policy questions. I think we can expect them to address technical questions.

MEMBER KRESS: The real overlap --

CHAIRMAN SHACK: What's a technical and what's a policy.

MEMBER KRESS: Real overlap in those issues.

MEMBER WALLIS: I object to some things called philosophical issues. I thought these were basic principles of how you went about doing a job.

CHAIRMAN SHACK: Okay, we can call them basic principles.

MEMBER WALLIS: What is it they're trying to do? Until you say what you're trying to do --

MEMBER APOSTOLAKIS: Could that be first?

MEMBER WALLIS: You don't design anything.

MEMBER APOSTOLAKIS: Can we discuss that first?

CHAIRMAN SHACK: Yes. I thought, I understood what the Staff was trying to do. The first couple of bullets on the first page is sort of my three-sentence description of what the NUREG is trying to do.

MEMBER APOSTOLAKIS: So which one are we looking at?

CHAIRMAN SHACK: Maybe that's the thing. Maybe we should go to these basic issues.

MEMBER APOSTOLAKIS: I think so, too.

MEMBER MAYNARD: Just for clarification, is this primarily to try to figure out what our approach is relative to the response on the NUREG --

CHAIRMAN SHACK: Yes.

MEMBER MAYNARD: Is that the primary purpose?

CHAIRMAN SHACK: I think that's the first order thing because we're running out of time. That's coming out in August. If we're going to have any input to that, we need to get to a committee position so that we can have input to that.

MEMBER MAYNARD: And realistically, what impact can we have on that? I kind of got the impression you're saying it's done and they're going to issue it.

MEMBER KRESS: But beyond that I think we need to decide on what we think a reasonable coherent technology framework is.

CHAIRMAN SHACK: That's a longer-term question.

MEMBER KRESS: As long as we're developing positions, we should keep that in mind.

CHAIRMAN SHACK: We're certainly going to do that, but as I say, I wanted to look at what we needed for the short term.

MEMBER KRESS: Now the NUREG is not necessarily the rule.

CHAIRMAN SHACK: It's certainly not the rule.

MEMBER KRESS: And it's not necessarily the end product of what they'll end up with.

CHAIRMAN SHACK: Maybe we don't have to discuss the NUREG. Maybe we just go ahead to where we think they should be in the longer term.

I thought there were important technical issues that we wanted to press for the NUREG, particularly the notion of a cumulative function.

MEMBER KRESS: I think there are a couple of real technical issues and that would be one of them.

CHAIRMAN SHACK: To me, the NUREG ought to be modified to include that. That would be sort of my position.

MEMBER KRESS: I think, in my mind, there's three primary technical issues that I want to see discussed with respect to just the NUREG itself. One of them is the --

MEMBER APOSTOLAKIS: So what are we discussing now, philosophical issues or something bigger?

CHAIRMAN SHACK: No, we're down to technical issues on the NUREG. I'm not sure exactly how to proceed here.

MEMBER APOSTOLAKIS: Let's start with philosophical and go down.

MEMBER KRESS: Okay, suits me.

CHAIRMAN SHACK: I'm afraid with the philosophical we can be there forever. I was sort of hoping the technical issues we could come to some agreement.

MEMBER APOSTOLAKIS: Doesn't the technical depend on the philosophical?

Graham wants to see metrics for every single thing they propose, right, that's what you're saying or something to that effect.

MEMBER WALLIS: No. I just say that an awful lot of it --

MEMBER APOSTOLAKIS: Choices are made with little justification or exploration of their impact. So there is no analysis and evaluation of various ways of describing the impact on public safety of nuclear reactor operation.

Criteria are not articulated and so on. I mean --

MEMBER WALLIS: But this is so global, I

don't think it's going to have any effect on the NUREG.

MEMBER APOSTOLAKIS: Does everyone agree that this is true?

CHAIRMAN SHACK: We can start taking soft votes on that.

MEMBER APOSTOLAKIS: Soft votes or maybe some discussion first.

CHAIRMAN SHACK: Well, discussion if there is some. I mean I'm not sure how I can discuss this.

MEMBER APOSTOLAKIS: May Graham can elaborate just a little bit? Give us an example.

MEMBER WALLIS: I had a great deal of trouble with this because I'm used to a design process where you start with some very clear top-level objectives and you say what you're trying to do and you try to express these in some kind of performance-based way. Whereas, what I see in the NUREG is apart from sort of talking about the QHOs at the beginning, there's a launching into a description of a framework without saying what performance-based objectives are being satisfied by the features of the framework.

For instance, I see these DBAs or whatever they are being inserted there simply by description without saying what they're for, what sort of performance you're aiming to achieve by inserting them and so on.

So I had trouble with the whole structure that's proposed. I had trouble with --

MEMBER KRESS: Did you have trouble with --

MEMBER WALLIS: I had trouble with Figure 6-2 appearing out of the blue without explaining what it's for.

MEMBER KRESS: Do you have trouble with them as concepts or the way they're presented?

MEMBER WALLIS: Well, first of all, I'd like an exposition on what kind of public safety you're trying to achieve by having this framework.

MEMBER ARMIJO: Can I help? The way I look at it, there are two types of figures. One is this step ladder thing, F versus C, and that to me serves two functions. And one of them addresses the concern that Graham has raised is that we will not accept any design in which there is -- there is a scenario that would violate that constraint.

The second type of graph is this complementary cumulative distribution function which says we will not accept any design in which the totality of scenarios that can be identified will violate this graph.

MEMBER WALLIS: The second one is more important than the first to me. And then the first one, the problem with that is that the way they do it, you can always get around it by reconstructing the PRA so that you have a sequence which doesn't violate your --

MEMBER APOSTOLAKIS: No.

MEMBER WALLIS: Why can't you do that? You can subdivide your sequences as much as you like until the frequency becomes the small --

MEMBER APOSTOLAKIS: They have put restriction son that. The discussion -- see, that was my first reaction too. But the discussion within each step of how you select the LBE precludes that because it says you start with an initiating event, right, and you find the frequency of all the things that can emanate from it, as I recall. I don't remember the exact detail.

MEMBER WALLIS: What's an initiating event? When there's an initiating event in the LWR, how do you define an initiating event? It's a pipe break. How are you going to subdivide your pipe breaks? You start subdividing it. You can always make the frequency of any one of them as small as you like.

MEMBER CORRADINI: Because you're making them into an infinite number of smaller events, is that your point?

MEMBER APOSTOLAKIS: Yes, you can break up a sequence --

MEMBER WALLIS: You have to because the scenarios are different for different --

MEMBER APOSTOLAKIS: But I think there are restrictions in the way you select the LBE that precludes that. That was my first reaction. I don't remember the details, but there is a restriction. So to me, it's equivalent to what they're doing. If I had the continuous curve, I decided to take pieces of intervals of frequency here and develop discrete, let's say the PDL, they will be equivalent because they're not saying any sequence that goes in here. They have some conditions.

MEMBER WALLIS: They have some mysterious thing about grouping sequences or classes of sequences.

MEMBER APOSTOLAKIS: But that addresses another issue that has to be --

MEMBER WALLIS: I think that we're sort of at the primary level though here, aren't we? We're setting down the top level criteria which I think is what you're trying to do. And then have things follow from that.

CHAIRMAN SHACK: But I think they've done that. When I look at it, I sort of tried to set it out here. They assume that the current regulations, the QHOs, the dose limits we have provide a suitable statement of the required level of safety.

Nobody disagrees with that.

MEMBER WALLIS: Not where the QHO was issued to that --

MEMBER KRESS: I don't disagree with that in a sense.

CHAIRMAN SHACK: I think that's where they start. There's an expectation of enhanced safety because they're going to apply the QHOs on an individual basis to the reactor and a group of plants.

MEMBER KRESS: And Dana made a very astute comment that QHOs are not individual plant characteristics.

CHAIRMAN SHACK: You can apply them to a plant and on a site.

MEMBER KRESS: But why would you do something that's wrong?

CHAIRMAN SHACK: Let me just -- let's just go there. That is the top level requirement. From there you get a framework for a neutral development, based on a full-scope PRA which we agree. They get LBEs from that PRA to represent the entire spectrum of events. They deal with integrated risk in terms of QHOs.

I think that's -- to me, there's a logical thing here.

MEMBER KRESS: Let me adjust that logic just a little. As I said many times QHOs are a site characteristic. I think they are the overriding risk metric, the safety goals and we need to strive to in our requirement, but they are a site characteristic. I'm saying that you don't design a plant to them because let's say you make the rules such that each plant just meets the QHOs. Then you can only put one plant on the site. And after QHOs, you can't do anything more.

My comment --

CHAIRMAN SHACK: That's a very poor choice on the designer's part.

MEMBER KRESS: Okay, but it's not either. I say the designer --

MEMBER WALLIS: But Fleming says that they apply to the group of plants on the site. Fleming says that.

MEMBER KRESS: Right, everybody knows that. I mean that's clear.

But what I'm saying is a designer who wants to have a design such that at least several of his plants can go on almost any site, but not all sites, almost any site and still meet the QHOs. That would be his objectives. And I'm saying the objective of a design safety set of criteria ought to be consistent with that consideration.

And I'm saying that if you give an equivalent of a CDF of 10^{-5}, and a LERF of 10^{-6}, if you're consistent with those, then that's consistent with the statement that any number of plants on any particular site will meet the QHOs. So that's where I disagree with their philosophy. They shouldn't -- QHOs should be implicit and it should be implicit with the concept that the designer needs criteria that if he meets those, that his design will be rendered to such that several such plants will fit on just about any site. That's a coherent concept. And that's where I think they've gone wrong. I don't think you want the QHOs to be the --

MEMBER APOSTOLAKIS: The staircase curve though really comes from existing regulations.

MEMBER KRESS: That's right.

MEMBER APOSTOLAKIS: I don't think it comes from the QHO.

MEMBER WALLIS: It doesn't come from the QHO.

CHAIRMAN SHACK: You also have to meet the QHOs.

MEMBER APOSTOLAKIS: It's a separate thing.

CHAIRMAN SHACK: Those are two. Tom is arguing that even the QHOs aren't enough.

MEMBER KRESS: I am saying that if you have the right CCDF, complementary cumulative distribution function, that's the overriding design requirement that can meet a CDF of 10^{-5} and 10^{-6}.

The QHOs are something that you want to have later on, but you do at the site. Is this site suitable? Have you met the risk goals for the site? That's also a requirement.

MEMBER APOSTOLAKIS: So the curve would be frequency of release, right, that's what you're saying?

MEMBER KRESS: Yes.

MEMBER APOSTOLAKIS: Not dose.

MEMBER KRESS: That's right. And that's

because that I can make equivalent to a CDF and a LERF.

MEMBER APOSTOLAKIS: Right, so that would be like a Farmer Curve.

MEMBER KRESS: Yes and then you wouldn't have to worry about the site.

MEMBER WALLIS: But the problem --

MEMBER KRESS: Except implicitly.

MEMBER APOSTOLAKIS: The problem --

MEMBER WALLIS: There's nothing in the regulations that says you will have this sort of a curve. QHOs are something already you can appeal to, something the Commission said.

MEMBER KRESS: I'm saying that those are a criteria also.

MEMBER WALLIS: I would like to have a cumulative distribution curve, but it's not in the regulations.

MEMBER KRESS: That's all right. We're re-doing the regulations.

CHAIRMAN SHACK: This is a new regulation.

MEMBER KRESS: I don't care what's in the regulations.

CHAIRMAN SHACK: This is consistent with current policy. Now it's a change in the regulations, but we're making a new rule. We can change the rule. The question is whether we want to change policy also.

MEMBER APOSTOLAKIS: The practical problem that I see, maybe it's not. Many years ago when I proposed something like that, Dana objected on the basis of what -- you can have 84 curves like that I think he said, because you don't have a common unit, what would you have?

MEMBER KRESS: Yes, curies, equivalent curies on a TEDI --

MEMBER APOSTOLAKIS: For everything?

MEMBER KRESS: The TEDI basis is equivalent curies.

MEMBER CORRADINI: Equivalent curies on what basis?

MEMBER KRESS: TEDI.

CHAIRMAN SHACK: Total effective dose equivalent.

MEMBER WALLIS: Like Roentgen-equivalent man.

MEMBER CORRADINI: So it's a curie times some sort of RBE?

MEMBER APOSTOLAKIS: And that curve would be used for design purposes.

MEMBER KRESS: No, it would be an

acceptance criteria for design. You would use, and actually you would have F-C curve like they have with design basis accidents as the design. But what I'm saying is that has to be constructed in such a way as to meet the CCDF curve that I'm talking about. If it's not, you have to put more restrictive -- figure of merit. I'm calling this a C curve. A figure of merit curve. It's the same thing as design basis accident and figures of merit. I don't really care, as long as you select your design basis accidents to be representative of all types so that you cover the whole range. I don't really care what you get for these F-C curves, as long as when they meet it, that they -- that it renders a plant to decide it meets the real CCDF curve.

MEMBER CORRADINI: So here's what I guess -- I think I understand what you're saying. I don't necessarily disagree with it, except for the fact are you going to totally a risk-based model for what's safe and what's not? Then I get somewhat twitchy because the technology-neutral document at least, and this I guess I was going to go back to Graham's question. I don't really, whether it's stair-stepped or a straight line or a line that kind of comes down or whatever, doesn't really bother me except for the fact that I would want to make them use that curve to elucidate the key accidents that it would have to worry about. Because eventually, it's going to be a series of a class of 5, 10 accidents that they're going to worry about, whether they're at power, not at power, changing fuel, whatever.

Once I see that grouping, then I'd scratch my head and say gee, something is missing from that. What did they do in the details? Did they fraction it at too much whatever? But it seems to me the L-C curve gets me an ensemble of accidents that I have to deterministically analyze. I have to deterministically analyze very carefully.

MEMBER KRESS: Very carefully, and probably it's hard to go into great detail on analyzing the frequency, but you could --

CHAIRMAN SHACK: So we're in violent agreement on the framework document on this point.

MEMBER CORRADINI: So let me just go on -- so let's say they do the ensemble. They do the calculation, blah, blah, blah, blah. What I'm trying to understand with your final point with the essentially frequency versus something curve, is that going to be a measure of acceptance? Then you become risk based for the license end of the plant.

MEMBER WALLIS: What other basis do you have unless you have an acceptance criteria of some sort.

MEMBER APOSTOLAKIS: You have the excellent deterministic calculations with the limits.

MEMBER CORRADINI: Yes, that's what I was going to say.

CHAIRMAN SHACK: But you have to meet them both.

MEMBER KRESS: You have to meet them both.

CHAIRMAN SHACK: You have to meet them both.

Let me just come back to Tom's thing -- this site versus plant design I think is a critical point.

MEMBER KRESS: I think it is too.

CHAIRMAN SHACK: I have a problem with that because we're going to do a full-scope PRA with internal and external events. I don't know how to come up with an external event without a site characteristic.

I'm going to do every generic, every design cert comes in here with a generic site where he does a reasonably robust serious earthquake, a reasonably robust serious meteorological problem. He does a sort of enveloping site. It may not be a worse case, but it takes it pretty -- that forces him to look in his design at both internal events and external events.

MEMBER KRESS: I accept. With the HBO, you've got to include things like that and transport and weather, the population distribution -- you don't have to do that with the seismic. Seismic you can choose a seismic curve and put it in your PRA.

I can say it's easy to do that.

CHAIRMAN SHACK: I can do 2 CFR 20.100. I can do dose at the boundary.

MEMBER KRESS: You need a wind rose.

MEMBER APOSTOLAKIS: How do --

CHAIRMAN SHACK: I can do a generic one and I don't see -- I don't particularly see what I get by not doing what every other design certification is done which is come in with a kind of a generic. Then when I'm done with that, if I can show my site fits that envelope I'm done. In your case, you would have to do a full level three at every site.

MEMBER KRESS: No, no, no, no, no. All I want -- I'm asking for a full level two for the design. And then for each site I want a level three. That's at a different state. That's a different requirement.

MEMBER APOSTOLAKIS: How do we demonstrate now that we meet the Part 100 criteria? Do we consider the site or each plant that is built on the site?

MEMBER KRESS: You do it on a plant by plant basis.

MEMBER APOSTOLAKIS: On a plant basis.

MEMBER KRESS: Don't constrict your thinking to what we do now.

MEMBER APOSTOLAKIS: No, but what I mean what they tried to do was to develop a framework that reflects that and your objecting to that?

MEMBER KRESS: Yes.

MEMBER APOSTOLAKIS: You are saying that should be really based on all the plants of the units that are on the site.

MEMBER KRESS: Yes.

MEMBER APOSTOLAKIS: And if you go to an earlier curve.

MEMBER KRESS: All we did for you was to tell you something about leakage rate data which was not risk related anyway.

CHAIRMAN SHACK: That's another thing, Tom. If we're going to go risk, do we even -- you're the one that always says we regulate lots of things beyond risk.

MEMBER KRESS: And I still say that.

CHAIRMAN SHACK: They've gone that.

MEMBER KRESS: That's why I want the OBEs to be every type of accident and I want there be consistent figures of merit on those that would regulate accidents that are beyond design basis or not beyond design. Lesser releases that don't involve full-core melt. That's the way you control those and I think you also use the LBEs as a way to invoke some defense-in-depth and some margins.

CHAIRMAN SHACK: Dana?

MEMBER POWERS: Just a question for Tom. How do you see Part 100? Part 100 says don't care about your accident frequencies. Hypothesize a substantial radionuclide release to containment. Tell me what happens at the site now?

How would you see that handled in the future?

MEMBER KRESS: I'll have to think about that one a second, but I don't that that has gained you very much in the current regulations other than say I have a containment that failed the modes imposed on it and I have a leak rate that's so small that I can meet that.

I don't think either of those are very substantial elements of design safety, but I think you can have a design basis accident that talks -- you have the design basis accidents that deal with LOCAs, that deal with the other accidents and I think you have figures of merit which involve release -- not a dose, but a curies of release. I think you meet those, the designer would have to do something.

MEMBER POWERS: The Part 100 requirement says don't care about design basis accidents.

MEMBER KRESS: I know, that's a defense-in-depth concept and I think you have to think about how to build defense-in-depth and do the design-basis concepts.

MEMBER POWERS: I mean --

MEMBER KRESS: And you may ask for meeting the figures of merit with some margin or --

MEMBER POWERS: Well, they do that.

MEMBER KRESS: Or some level of confidence and that may -- I think you deal with it in that sort of way, but --

MEMBER POWERS: They meet it in this requirement by -- they don't have it frequency independent, but they will put it at such a frequency that you have to deal with it. You have to deal with it in a conservative way looking at sort of the highest frequency, the highest dose sequence and meeting it so that it's reasonably equivalent to the current requirement, not quite.

MEMBER ARMIJO: I'm going to put on my designer hat, okay and somebody is going to tell me what the high level requirements are. High level requirements is that the risk associated with all the accidents that can potentially occur from this, in this particular design shall not exceed a certain limit dictated by this -- whatever, the complementary cumulative distribution function.

Second requirement --

MEMBER KRESS: Now keep in mind that that's not a risk of latent cancers. It's a risk of a certain release.

MEMBER ARMIJO: Right.

MEMBER KRESS: It's like a core damage frequency. It's not a risk of --

MEMBER APOSTOLAKIS: Right now, risk is in terms of dose, isn't it?

MEMBER KRESS: Well, in the --

MEMBER APOSTOLAKIS: What they propose?

MEMBER KRESS: Yes.

CHAIRMAN SHACK: It's a dose large enough to cause serious problems.

MEMBER APOSTOLAKIS: It can go all the way.

MEMBER ARMIJO: So this is higher level requirement number one. There's another high level requirement which is the consequences of any single accident that I can dream of shall not be in excess of a given limit dictated by a curve, whether it is that --

MEMBER WALLIS: That's consequence.

MEMBER KRESS: Keep in mind that that second level could show up on this CCDF curve because it's dominant -- what it is is accumulated frequency of the ceiling. If you drop above that line in one little area, that's going to be do to these meeting, not meeting those other requirements in that particular set of frequencies.

It could be in that too.

MEMBER ARMIJO: Let's say we have these two requirements. A constraint on the harm that can come from all the accidents that I can dream of and the constraint on the consequences of a single scenario and I have two constraints. If I do the PRA and I plot each scenario on the first curve that limits the consequences of an individual accident and

I'm going to be careful like George said, I'm going to put arrow bars, horizontal arrow bars on the consequences, horizontal, vertical arrow bars on the probability and I will show that each and every event that I can dream of is below that limit.

MEMBER KRESS: That's right.

MEMBER ARMIJO: Now the next thing I'm going to do, I'm going to look at, group these various events and look at the ones that give me the highest consequences in each category and then add all those up and show that I'm going to satisfy the constraint on the total.

MEMBER APOSTOLAKIS: No, I disagree with that.

That's not right. You can't do that.

MEMBER KRESS: You're going to do the PRA.

MEMBER ARMIJO: Right.

MEMBER APOSTOLAKIS: Wait a minute. What Sam is saying is that I will be risk informed now and then a few minutes later I will cease being risk informed and I look at the worst possible consequence.

MEMBER ARMIJO: No, no, no. I'm going to add all the potential --

MEMBER APOSTOLAKIS: On what basis? I mean they have different frequencies.

MEMBER KRESS: You're going to do a PRA.

MEMBER APOSTOLAKIS: On what expected consequence?

CHAIRMAN SHACK: You do the PRA to get -- your PRA end state is a dose release and you add all those.

MEMBER APOSTOLAKIS: You add what?

CHAIRMAN SHACK: A release of some sort. You get all those sequences --

MEMBER KRESS: Just do the normal PRA.

CHAIRMAN SHACK: He limits to make sure that every sequence is below the one curve, and the total sum of all the others is below the second curve.

MEMBER APOSTOLAKIS: Of all the others?

CHAIRMAN SHACK: Of all the sequences.

MEMBER KRESS: Just the PRA.

MEMBER APOSTOLAKIS: Why? On what basis?

MEMBER KRESS: Because that's your --

MEMBER APOSTOLAKIS: You have one sequence at least to this consequences with frequencies -- how do you know it went with another frequency?

MEMBER WALLIS: No, I think he's saying you add up all the frequency times consequence.

MEMBER APOSTOLAKIS: What about the expected consequence. You guys are saying no.

MEMBER WALLIS: I think that's what he's doing.

CHAIRMAN SHACK: The expected consequence.

MEMBER APOSTOLAKIS: The expected consequence.

CHAIRMAN SHACK: You have to have greater than 95 percent confidence with that.

MEMBER KRESS: I would use the 95 percent confidence --

MEMBER APOSTOLAKIS: If you expect the consequence, yes, it's fine.

MEMBER KRESS: You got the right idea. Now the question is --

MEMBER APOSTOLAKIS: Wait a minute --

MEMBER KRESS: -- how do you select this figure of merit curve.

MEMBER APOSTOLAKIS: Wait, wait. That's what the Staff is saying though.

CHAIRMAN SHACK: What the Staff doesn't do is sum all the sequences.

MEMBER KRESS: They left that out.

CHAIRMAN SHACK: What they do is they sum the big accident sequences.

MEMBER APOSTOLAKIS: The other ones drop out.

CHAIRMAN SHACK: Well, they drop out if you don't have a CCDF curve and you haven't limited the total risk profile.

MEMBER KRESS: That's what the EIA PRA does already. Why not do that?

MEMBER APOSTOLAKIS: They are asking you after you satisfy the curve, the staircase, to also meet the QHOs.

MEMBER KRESS: No, no, that's different.

MEMBER APOSTOLAKIS: That's what they're saying.

MEMBER KRESS: I know but that's what --

MEMBER APOSTOLAKIS: No, no. Forget about the site versus the other thing. The thing is that they are putting a condition like the one Said mentioned on the total.

MEMBER WALLIS: That's right.

MEMBER APOSTOLAKIS: Now you may disagree and say I don't like how they're putting at the QHO level. I want it at the lower level like the release, but the philosophy is there.

CHAIRMAN SHACK: Tom wants it at a wider range of consequence levels, not just --

MEMBER CORRADINI: I think what he's saying, what I heard him say is that he wants --

MEMBER KRESS: Or one point.

MEMBER CORRADINI: He wants to look at the shape of it. I mean what you guys are saying is this and you're saying if you do whatever you said, expected consequence, you're looking at essentially the product of all of these has got to be less than an X.

What he wants to look at is the shape of this and go hm, that's a weird shape out there. What's causing that? I might worry about that. That's what I -- it's the shape, how this develops.

MEMBER KRESS: I don't care what shape it is as long as it's under that.

MEMBER CORRADINI: Right. But if something is popping up, getting close, I would look at it.

MEMBER KRESS: That's exactly right. And I'm saying that if that is a curies of release equivalent that I can make it very completely consistent with the CDF and a LERF which have both been shown to be really neat design attributes.

MEMBER APOSTOLAKIS: How can that be consistent with LERF when LERF ignores the amount released?

MEMBER KRESS: Because my -- I would have the access to see the ratio of the curies released to the curies that are now released that would bound the LERF from an LWR that we now have. That brings it in there. Now it's a little tricky. You have to either bound it or have a representative value and that's why I say it's consistent with the LERF. It's the integral under that curve.

MEMBER WALLIS: What you guys are doing is what I wanted to see in Chapter 1 which was a description of the ways of representing risk, the ways of making a decision about what we're going to do and the a decision about which ones we're going to choose.

MEMBER APOSTOLAKIS: But Graham, it seems to me a lot of what you want is there. It's just not in the first chapter.

MEMBER WALLIS: It's not clarified.

MEMBER APOSTOLAKIS: And you use the staircase curve in Chapter 6 and that bothers you.

MEMBER WALLIS: It comes out of the blue. I don't understand why it's there and --

MEMBER APOSTOLAKIS: But it's a matter of presentation.

MEMBER WALLIS: I disagree with the staircase too because I don't understand this trying to -- to regulate an individual PRA sequence. I think that's a fundamental flaw. You've got to integrate on the basis of some total thing.

MEMBER APOSTOLAKIS: The moment you look at this interval and then they say identify the sequence with a larger consequence --

MEMBER WALLIS: I understand that. Then you look at it more carefully.

MEMBER KRESS: Yes, you use a very good curve, you use a good tool to calculate those consequences.

MEMBER APOSTOLAKIS: These eliminate this trick of subdividing because they're saying forget now about frequencies.

MEMBER WALLIS: You can always subdivide.

MEMBER KRESS: It eventually does or it can.

MEMBER APOSTOLAKIS: And you may need to put a few extra words, but the idea is there. They thought about it that you cannot subdivide. And I thought it was pretty good.

MEMBER WALLIS: I thought it was incredibly confusing.

MEMBER APOSTOLAKIS: It's difficult because they're not the end, they pick one frequency from some -- here and the consequence from there and create a stylized sequence that will be analyzed. But again this is too detailed. This letter will not approve everything they say, right? Will it?

MEMBER KRESS: I don't think so.

MEMBER APOSTOLAKIS: Then we're in trouble.

MEMBER CORRADINI: So can I ask another question? Are we off this or do you want to --

CHAIRMAN SHACK: I'd like to start getting into some issues that we can maybe agree on.

MEMBER APOSTOLAKIS: I think the way Said put it would satisfy Graham and my contention is that a lot of this stuff is already there.

MEMBER KRESS: Right.

MEMBER APOSTOLAKIS: With a disagreement as to where you put the curve, which curve is it.

CHAIRMAN SHACK: I look at that as Issue 8 under technical issues. I think we want both the sequence curve and the cumulative curve.

MEMBER KRESS: I agree.

CHAIRMAN SHACK: That's where we'd like to come to some sort of consensus.

MEMBER WALLIS: Why is there no societal risk in here? Why is there no environmental --

MEMBER CORRADINI: You are adding more

QHOs.

MEMBER WALLIS: That's policy.

MEMBER KRESS: I think you have to have that too.

MEMBER WALLIS: You have to have that in Chapter 1.

CHAIRMAN SHACK: No, that sort of says what does my frequency consequence curve include? I would argue that you want eight, whether we have societal risk or we don't have societal risk.

MEMBER WALLIS: Well, explain that at the beginning.

MEMBER KRESS: I agree with you.

MEMBER WALLIS: Explain that.

CHAIRMAN SHACK: I think from the top level, that's a different question, what the top level requirements -- but for any top level requirement, we should look at individuals and we should look at cumulative.

MEMBER KRESS: Absolutely.

CHAIRMAN SHACK: We can avoid the policy decision on number eight and say we have a consensus on number eight.

MEMBER APOSTOLAKIS: I want to understand this first. When you say cumulative, I mean is it the cumulative curve or the number that Said mentioned, the expected value of the consequence?

CHAIRMAN SHACK: Expected value, cumulative.

MEMBER APOSTOLAKIS: That's not what Tom wants I think.

MEMBER KRESS: I want you to take this set of licensing basis events with the figure of merit curve and design your plan to it. But then you have a plant design. Then I want you to go back to your PRA and calculate a cumulative complementary distribution function with the PRA.

MEMBER APOSTOLAKIS: Right.

MEMBER KRESS: And meet my new curve there which is a design acceptance curve.

MEMBER APOSTOLAKIS: So that's not a single number.

MEMBER KRESS: It's a curve.

MEMBER APOSTOLAKIS: It's a curve that satisfies --

MEMBER KRESS: Right. That's exactly what I want.

MEMBER APOSTOLAKIS: That's different than what Said said.

CHAIRMAN SHACK: No, that's what Said

said.

MEMBER KRESS: I think basically it is.

MEMBER WALLIS: How would draw the curve, Tom? Infinite number of curves which you can draw.

MEMBER KRESS: There's only one curve that will fit a CDF and a LERF.

MEMBER WALLIS: No, there's two points. A curve is the whole continuous frequency consequence.

MEMBER KRESS: Yes, but the LERF is an integral under that curve.

MEMBER WALLIS: Yes, but they're all kinds of curves that have the same integral --

MEMBER KRESS: But I add a condition to that and my curve -- you're right. My curve -- I impose a condition of a non-risk averse.

MEMBER WALLIS: Okay. So you --

MEMBER KRESS: You're absolutely right. If you impose that condition, then my curve is correct. But you can also make it risk averse if you want a different curve. That's a policy issue.

MEMBER APOSTOLAKIS: So you want an integral part on eight, but I don't think the wording of eight is correct, that these sequences can be arbitrarily changed.

MEMBER CORRADINI: Which eight? Eight

comma under technical issues, not Graham eight.

MEMBER WALLIS: Where is eight?

MEMBER CORRADINI: Eight parentheses, technical issue number one.

MEMBER WALLIS: I think I would agree with that.

CHAIRMAN SHACK: Okay, we agree on something.

MEMBER CORRADINI: Can we circle it just to make sure we don't go back on ourselves?>

(Laughter.)

So on page one, number eight, I can circle it?

CHAIRMAN SHACK: We can circle it.

MEMBER WALLIS: Isn't that what's in the QHOs? The QHOs are the summation of overall risk. Isn't that what the first QHO is, it's the total risk -- isn't that the same thing.

CHAIRMAN SHACK: Only if your PRA is calculating essentially CDF and LERF.

MEMBER WALLIS: No, no, no.

CHAIRMAN SHACK: You're calculating more consequences and this is an extended PRA.

MEMBER KRESS: This covers the whole range of frequencies and consequences.

MEMBER APOSTOLAKIS: But you have to make it clear that you're talking about the complementary cumulative distribution function, not just summary.

CHAIRMAN SHACK: The Staff knows what we're talking about.

MEMBER WALLIS: This is something else. The additional acceptance criteria and the sums over a risk, that's simply the excepted dose. That's one thing. It's not a curve.

MEMBER KRESS: No, this is a release.

MEMBER WALLIS: We're not talking about a curve here.

MEMBER KRESS: This is a frequency of release. Frequency of exceeding that a certain release value.

MEMBER CORRADINI: We haven't left this, so can I ask my question at this point? Maybe it's -- you can rule me out of order. If right now by regulation the licensee has to do these sorts of calculations, but everything, back to my cartoon, everything that the licensee has to deal with in terms of design space or DBAs over on this side, they do the calculation. They find out what their site here is, but there's nothing to compare to over here. There's just kind of a like this sort of thing with a CDF and a LERF and if it's less than 10^{-5} or 10^{1-6}, they get the thumbs up. Right? That's the current method.

By what you're saying here is more than that. You're not only saying develop a curve and do that sort of approach. You're saying regulate out in this space.

CHAIRMAN SHACK: Again, in their enhanced safety, they've already agreed that they want the new reactors to meet the QHOs which essentially is regulating out in that space, given Tom's objections over whether we're really a QHO or someplace else, but we're basically doing that.

MEMBER CORRADINI: So my question is and I guess it kind of goes back to -- Dana said something the last time we were going through all this, the only place -- the only way I can imagine with the new designs that you would violate out here and yet satisfy in here is some sort of large common mode failure which is external. I can't think of any of the new designs that they are going to have a problem out here and not a problem in here that's an internal.

So my question is why would I regulate a design certification out here since we're now back to site dependency.

MEMBER KRESS: The design curve.

MEMBER CORRADINI: No, but do you understand my point? My point is you agreed with me that the advanced designs, if they violate, they'll have a violation here and here, right? It's hard for them to be violating out here because they're driven by external events. External events is a site issue.

MEMBER WALLIS: No, they're not. They're driven by major accidents of any kind.

MEMBER CORRADINI: I don't see any of the new designs, practically speaking.

CHAIRMAN SHACK: With internal events, your CDFs are very low. Under seismic, you're still somewhere in the order of 10^{-5}.

MEMBER WALLIS: That's where we want them to be.

MEMBER CORRADINI: Okay, so my practical question is, my practical question is you just told me that we've invented a scheme that's irrelevant out here because it's site dependent more than design dependent.

MEMBER WALLIS: We've made them so safe that something else matters, is that what you're saying?

MEMBER CORRADINI: Yes.

MEMBER WALLIS: So safe against internal

events that something else is going to govern design?

MEMBER CORRADINI: Yes. So I'm back to my question which is is the right-hand branch out of here essentially dominated by site events and so it's a whole different ball game? That's what I --

MEMBER APOSTOLAKIS: The law of probability --

MEMBER CORRADINI: Yes.

MEMBER APOSTOLAKIS: Here, it is dominated by those, I think.

MEMBER CORRADINI: So we can argue about all this stuff, but we're kind of --

MEMBER APOSTOLAKIS: Guys, when you say we agree on 8, what exactly are we agreeing?

MEMBER WALLIS: What are we agreeing on, yes. I want to know what we're agreeing on.

MEMBER APOSTOLAKIS: Are we agreeing in principle? Are we going to write a letter that reflects this?

CHAIRMAN SHACK: I think we want to write a letter that reflects that the NUREG should include the complementary cumulative --

MEMBER APOSTOLAKIS: Okay, now can we reserve judgment?

CHAIRMAN SHACK: The question is what is

that curve that they're supposed to meet? I would argue that the staff would get it by looking at the current regulations, the current reactors, finding out what that looks like for the current thing and you've said it's okay.

MEMBER APOSTOLAKIS: But what would they put on the horizontal axis? What would you put on the horizontal axis? That's a serious disagreement here, isn't it?

MEMBER CORRADINI: Detail, detail.

MEMBER APOSTOLAKIS: Detail?

CHAIRMAN SHACK: I would put dose because that's the way the current regulations --

MEMBER CORRADINI: Just so I'm clear, if you put dose, then I'm back to my point about the site.

CHAIRMAN SHACK: My problem with Tom is Tom's change is a policy change.

MEMBER KRESS: It's not a policy change.

CHAIRMAN SHACK: Well, you have to turn all these dose limits into -- maybe it isn't a policy change. Maybe you could do it in terms of releases.

MEMBER KRESS: It's a very --

CHAIRMAN SHACK: It's a minor extension of the current.

MEMBER KRESS: It's a very rational thing to do because a designer doesn't have any idea what society is going to have to --

CHAIRMAN SHACK: I claim the generic site is good enough.

MEMBER APOSTOLAKIS: If you have iodine curies and you have cesium curies, then you go through this intermediate thing as you say, the cesium curies are equivalent to so many curies? Is that --

CHAIRMAN SHACK: Dose conversation, right.

MEMBER KRESS: It's dose conversion.

MEMBER APOSTOLAKIS: How is that different from what the staff is doing?

MEMBER KRESS: Because they have to talk about some generic site characteristics where they have a wind rose and they have a distance to the site boundary.

MEMBER APOSTOLAKIS: Okay, okay. You have eliminated some of that requirement.

MEMBER KRESS: Yes, I'm taking that out.

MEMBER POWERS: George, the rem-rad conversation is pretty easy for gamma data, some of these modern -- some of these advanced reactors that are focusing on actonite systems, things like that, the conversion is not so obvious. To me, it's more complicated to do.

MEMBER APOSTOLAKIS: But it can be done.

MEMBER POWERS: Yes, the 10 CFR Part 20 tells you exactly how to do it.

MEMBER APOSTOLAKIS: Okay.

MEMBER CORRADINI: For every isotope.

MEMBER POWERS: There may be a few that are not in there, but nearly everyone is in there.

MEMBER KRESS: I think you can pretty well --

MEMBER APOSTOLAKIS: So we still don't know whether we all agree as to what the horizontal axis should be.

CHAIRMAN SHACK: Right.

MEMBER APOSTOLAKIS: But we agree that in addition to the staircase that the Staff is proposing, there should be some integral evaluation which is sufficiently different from what they're proposing already which is to check with the QHOs.

I'm not happy with that.

CHAIRMAN SHACK: I'm not sure it's all that different.

MEMBER APOSTOLAKIS: And then what on earth is the disagreement?

CHAIRMAN SHACK: My interpretation --

MEMBER APOSTOLAKIS: I think a major disagreement is what Tom is raising. He wants to see curies. The Staff says no.

CHAIRMAN SHACK: I think the major disagreement is he wants to propose a whole lot more conservatism on the acceptance criteria.

MEMBER WALLIS: I think you're crazy to try to design this in a meeting of a couple of hours.

MEMBER KRESS: You know, all the utility requirements documents, all the things we talk about in new plants say our goal is to have a CDF of 10^{-5} and a LERF at 10^{-6}. My curve would just make it the policy. That would put --

CHAIRMAN SHACK: But they're thinking internal events when they make those statements.

MEMBER KRESS: I don't care what the events are.

MEMBER APOSTOLAKIS: Do you know what would help a lot here, to do what Graham wants. Why don't we try or maybe the Staff can do it or we can do it or somebody, have a slide with the actual requirements up front.

MEMBER WALLIS: You're going to ask us to redesign the framework in one meeting here?

MEMBER APOSTOLAKIS: No, I'm trying to

support you and you turn around and hit me.

(Laughter.)

MEMBER WALLIS: No, no, no, no. I agree to.

MEMBER APOSTOLAKIS: That will teach me in the future. This is a great lesson.

(Laughter.)

MEMBER WALLIS: I agree. I just think, George, to do it properly is not something you're going to do in a meeting.

MEMBER APOSTOLAKIS: I understand that, but what I'm saying is because of this -- I must say I'm still not very clear regarding what Tom is advancing. I'm not saying I disagree. If we had a list that says here are the actual performance requirements that the Staff has imposed. Regarding number three, Kress disagrees and wants this. Regarding number five, somebody else disagrees. That would make it much clearer and then we can put it in --

MEMBER KRESS: Let me clarify things with the simple analysis. If we were to be designing a current LWR, we would have a set of design basis accidents. We would have figures of merit and they would be required to meet those, but we would also ask nowadays once you see the F in your LERF, and we'd like for you to have 10^{-4} and 10^{-5}, okay. Now let's say we -- that turned out to be a good idea.

Now let's say we wanted to do that with the new framework. We'd have design basis accidents. We'd have a figure of merit curve and we'd also ask what's your CDF and LERF? Oh, I don't know what that is because our plant doesn't have CDF and LERF. Well, we can ask them what is their CCDFC curve is because it's the same thing as a CDF and a LERF, not exactly, but it's consistent with it and we know what level to put it at because we're asking now for 10^{-5} and 10^{-6} to be consistent with the international thinking, the utility requirements document, the desire for a higher level of safety for new plants, for lots of reasons.

So it's a direct analogy to what we do now. It gives them a really fine set of criteria to design to and a way to do it and a way to impose defense-in-depth through the design basis.

MEMBER WALLIS: What you're saying essentially, Tom, is that CDF and LERF have been very, very useful.

MEMBER KRESS: Absolutely.

MEMBER WALLIS: For many years and this usefulness should not be discarded by using something completely different.

MEMBER KRESS: Wonderful. That's exactly what I'm saying and I'm saying you could do it --

MEMBER APOSTOLAKIS: We are using too strong a word, because what the Staff is proposing may have it already been --

MEMBER WALLIS: It's not clear that it's there.

MEMBER APOSTOLAKIS: It should be more evident. I think that's more appropriate.

MEMBER KRESS: It's not already built in. If you go straight to the QHOs, you bypass it, the CDF --

MEMBER WALLIS: You need the Chapter 1 which says how we got these useful things we want to see in the framework such as an equivalent to CDF and an equivalent -- I just think if the Staff doesn't listen, then nothing is going to happen.

MEMBER KRESS: Oh, they're listening. Marty listens.

MEMBER APOSTOLAKIS: The issue here is what to put in the letter, not what the Staff does. Because if we open it up --

CHAIRMAN SHACK: I'm not sure that we're getting any closer as an ACRS to agreement.

MEMBER APOSTOLAKIS: I want advice for my letter.

CHAIRMAN SHACK: We have another hour to go yet, George.

MEMBER APOSTOLAKIS: No, 55 minutes.

MEMBER ARMIJO: The thing is not ready to go. It's not ready to go.

CHAIRMAN SHACK: It's ready to go. We're not ready to agree on anything.

MEMBER ARMIJO: We could write a letter and say it's not ready to go.

MEMBER WALLIS: That's right.

MEMBER ARMIJO: This is not ready to go and we're not ready to give them decent advice. That's all there is to it.

MEMBER APOSTOLAKIS: I think if we do what I suggested in terms of two slides, putting down the requirements specifically the way Graham wants them, the way Said wants them, and then ask Tom to tell us which one he would change. That will go a long towards reaching consensus.

MEMBER WALLIS: But then you're establishing --

MEMBER ARMIJO: Right now, what is -- what determines the maximum acceptable consequences of a single event of a given frequency in the framework? It is the stepladder.

MEMBER APOSTOLAKIS: The stepladder.

MEMBER ARMIJO: Okay. Second question. What determines the total cumulative consequences of all possible scenarios in a given plant?

MEMBER KRESS: There, there's two things. One of them is this CCDF curve with --

MEMBER ARMIJO: No, no, currently.

MEMBER KRESS: That's what I meant.

MEMBER APOSTOLAKIS: They ask you to meet the QHOs. That's an integral quantity.

MEMBER KRESS: Yes, but --

MEMBER APOSTOLAKIS: Don't dismiss that.

MEMBER WALLIS: It's an expected dose and should have a measure of expected dose consistent with the QHOs.

MEMBER APOSTOLAKIS: You need more than just a dose to -- because the QHO is in terms of individual risk.

MS. DROUIN: I don't know what to say because I don't understand the question to be quite frankly.

MEMBER ARMIJO: We are trying to impose two constraints, one on the maximum acceptable risk or maximum acceptable consequences of a single event. This is sort of a decision that you know we will not accept a plant that has a single event with consequences that exceed a certain limit in each frequency range.

MEMBER WALLIS: In each frequency range, that's different -- but why do you have dispersion in the frequency range?

MEMBER MAYNARD: That's consistent with the current requirements, the current regulations and it's easy to, I think, to explain that and to show that. That's where the existing requirements come from.

MEMBER ARMIJO: And the next constraint that we would like to impose is what is the total risk associated with all potential accidents that we can identify for that particular design?

MEMBER KRESS: And where risk here is defined as release of fission products. I think there's a third constraint and that is you also must have a site that meets the QHOs and that depends on the site characteristics, the number of plants there are, their power, the type of plant. So you need the three constraints. That's what I'm saying.

MEMBER ABDEL-KHALIK: Mary is going to ask about the second constraint. Is there one?

MS. DROUIN: I don't understand. Are you asking me if I agree with you.

MEMBER ARMIJO: Where in the current framework do you have those constraints or do you have those constraints in the current framework? Because I guess somebody saying yeah, they exist and somebody is saying no, they don't exist.

MS. DROUIN: Chapter 6 --

MEMBER ARMIJO: Gives the constraints on the first one.

MEMBER APOSTOLAKIS: You have the staircase --

MS. DROUIN: Right, all of that is in Chapter 6.

MEMBER APOSTOLAKIS: You have the requirement of the QHO.

MS. DROUIN: And it's probably also in Chapter 3. I didn't bring a copy of the former document with me, but --

MEMBER WALLIS: Three has the step curve too. It doesn't explain it.

MEMBER APOSTOLAKIS: What's missing is this CDF and LERF --

MS. DROUIN: And it will also be discussed in Chapter 8. Chapter 8 is the chapter that says how this stuff is imposed from a regulatory perspective.

MEMBER WALLIS: But why did you want that frequency? Why did you want that F-C curve in the first place?

MEMBER KRESS: It's just a figure of merit --

MEMBER WALLIS: Why that? Why not something else like the cumulative.

MEMBER APOSTOLAKIS: Because they want to define the accidents that will replace the design basis.

MEMBER WALLIS: But why? Why do you need to replace the design basis?

MEMBER APOSTOLAKIS: Because the whole idea is to be risk informed. The design basis accidents are --

MEMBER WALLIS: No explanation in this report about why you have to have a DBA --

MEMBER APOSTOLAKIS: They are replacing the traditional deterministic DBAs.

MEMBER WALLIS: Why?

MEMBER APOSTOLAKIS: By something that is risk informed.

You have to go to the intervals of --

MEMBER KRESS: The reason is you can't rely on the calculations of the PRA because they don't have enough thermal hydraulics. So you use the design basis accident.

MEMBER WALLIS: And that needs to be explained. That's not in there.

MEMBER KRESS: I know, but you're complaining about what they talk about and not what they're doing.

MEMBER WALLIS: I'm talking about the whole thing.

MEMBER POWERS: Please continue with your explanation because I personally think that design basis accidents is not only an anachronistic concept, it's a flawed and useless concept.

MEMBER APOSTOLAKIS: It's what?

MEMBER POWERS: Flawed and useless.

MEMBER WALLIS: Thank you. That's a very good statement. Now that has to be rebutted somehow.

MEMBER KRESS: I personally think you have an option. Let's say you have completely risk-based regulations where you use the PRA and say you must meet the PRA risk things that could be CDF and LRF equivalents and it could also be the QHOs.

Now I don't think in my mind that -- you could also have uncertainties and say they have to meet these certain confidence level, but I personally believe that the design basis accident concept gives you two things beyond that or three. One of them is the PRA normally doesn't deal with releases that are not core melt releases, they're small releases, releases from the --

MEMBER WALLIS: Well, the new one will. The new one will because it's dose overall whole range.

MEMBER KRESS: Maybe, but not -- I haven't seen it yet. But anyway, the design basis accident gives you a way to look at all the range of accidents whether they contribute to risk or not, but they're things that happen that in a regulatory sense you don't want to happen. They could be small releases. They may just be things that occur and don't even give you a release hardly. That's number one.

The design basis accident gives you the ability to have a very detailed consequence analysis that I don't think for a specific set of representative-type accidents, I don't think there's such an ability in the PRA to do. It gives you the concept of a regulator looking at what you do and improving your calculation of two and actually seeing that it's appropriate and has appropriate detail in it. It also gives you what I would call the concept of a design licensing basis which has lots of things associated with it and that is ways to get margin, ways to get defense-in-depth, ways to invoke some form of defense-in-depth and margins. It gives you all the good things about the design basis concept we have now, but then you say well, design basis concept is a bit of a construct and its purpose is to have you look at all these things, but it's primary purpose is to render a plant to a design that's acceptable risk. But it doesn't give you that.

MEMBER WALLIS: Can you justify that with LOCA? I mean how does the design basis LOCA help you to do anything about submitting risk from LOCAs?

MEMBER KRESS: It doesn't.

MEMBER WALLIS: It doesn't. It has nothing to do with it.

MEMBER KRESS: I was just getting ready to say that it doesn't tell you the risk. It gives you an implied good feeling that you design this system that may have risk, but then you say oh well, what do we do? We go back to the PRA. We go back to the PRA.

MEMBER WALLIS: Focus on the things that are risky, not some artificial thing that's not --

MEMBER APOSTOLAKIS: That's what they do.

MEMBER KRESS: And if your PRA tells you that you haven't met your goals within a certain confidence level, then you go back and change the DBAs or change their figures of merit. You do something that causes the design to get better so it can meet your risk objective. You've got to do both. And that preserves --

MEMBER APOSTOLAKIS: The PRAs --

MEMBER POWERS: For one, you the designer, can hypothesize all the DBAs you want to and do your design any way you want to. All I'm going to do is look at your risk assessment and one other thing and the iteration you did to get that risk assessment, I really don't care how you got there. I only care that you got there. Why wouldn't that be fair, Tom?

MEMBER KRESS: Well, then the PRA becomes the last thing basis.

MEMBER CORRADINI: That's where I have a problem, Dana. I just want to jump in and say if I believe the simulation tool from the point that I could run 10,000 simulations and generate the curve in the uncertainty, I'd buy it. But I don't believe the simulation tool is that good.

MEMBER POWERS: So improve it. As I said, there's one other thing.

MEMBER CORRADINI: What's that?

MEMBER POWERS: And the other thing I do is I say okay, I'm pretty sure that there is probably a flaw in your simulation to where you caused it. It was written by Theodophonos, so I know it's flawless, but there might be a flaw in it. And so I say now despite all your evidence to the contrary, hypothesis is you release a substantial amount of radioactivity in the containment. Tell me what happens to the site boundary?

Do a Part 100 analysis for me. And tell me what happens.

MEMBER KRESS: I think somewhere along the line we decided that that concept of releasing an artificial fission product source term in the containment and calculated doses at site boundary, didn't really do anything to reduce the risk.

MEMBER CORRADINI: I want to play along. Tell me the design basis accident for the containment that keeps it below an acceptable thing at the site boundary and I'll play the game. Because if you look at 10 CFR 100, the DBA with the maximum credible accident is actually a LOCA.

MEMBER POWERS: No.

MEMBER CORRADINI: Yes, it is. If you look at the temperature pressure --

MEMBER POWERS: It is not. It is not.

MEMBER CORRADINI: What is it then?

MEMBER POWERS: It is a core melt accident.

MEMBER CORRADINI: That's the source term, but the load that is put on the containment to meet the .1 percent per day is a LOCA. So you've got this screwed up situation where you've designed a barrier based on a loss of coolant accident, but you've designed a release based on a source term which can never happen from a LOCA.

MEMBER KRESS: It's a design basis concept.

MEMBER POWERS: I simply don't care. I don't care because I'm saying your calculational tool, your calculational tool, I'm sure again it was written by the esteemed professor from the University of California at Santa Barbara, I'm sure it's flawless, but on the off chance that maybe one of your graduate students who snuck in from Dartmouth and wrote a section of software in there and screwed it up, made a mistake, show me that you have this defense-in-depth capability.

I'm also going to ask you about your review emergency evacuation, but that's kind of methodic.

MEMBER CORRADINI: How are you going to identify, just so I'm -- I don't disagree with the approach, but somewhere in there you're assuming a barrier at the containment which is the containment system and somebody designed that and they need a series of design specifications for that which means you're back to a design basis accident.

MEMBER POWERS: And I say yes, you have a design for this containment. I'm sure you did a good job on this. You have a design basis -- I'm sure you did a good job on this, please tell me what happens to the boundary because it's a defense-in-depth measure. And other than that, I don't care.

MEMBER CORRADINI: But I guess, in some sense, the only thing that still gets me and this is just -- I might not be getting it. I've seen other things that were potentially, eventually if they ever get built regulated on risk base versus risk informed and the first attack on the reasonableness of it is the fact that I'm doing simulations and at the very low probability high consequence, I can't be sure of the uncertainty in the simulation.

MEMBER POWERS: And it will come in in spades in the gas-cooled reactors, for instance.

MEMBER CORRADINI: I actually agree with you there.

MEMBER POWERS: All the source-term models are all screwed up.

MEMBER WALLIS: So what you guys are doing now is what should be in Chapter 2. You look at your objectives and you look at alternative ways to meet them, one of which is Dana's, one of which is Tom's, one of which is -- you know -- and you decide why you --

MEMBER CORRADINI: The only reason I spoke up at this point is Tom gave all the attributes of why you need some sort of set of accidents to work through the design because eventually, when you get to the designer, unless we get much more sophisticated and I'll be dead and a couple of grand kids will be dead, I'm not sure you're going to be able to get past some deterministic method of an engineering system and what that engineering system has got to essentially withstand.

MEMBER POWERS: Let me explain why I would take what Tom told me about his design basis accident and I would turn it right around and say yes, you're absolutely correct, Tom. Everything you said was absolutely correct. What you are doing is proliferating a huge number of requirements, most of which are not of any use because they focus on accidents that don't occur.

MEMBER WALLIS: That's another question is why you have all these requirements. There's nothing in this framework about what's really necessary and why this is efficient and all that. There's not criterion at all. It's simply describing a whole lot of requirements.

MEMBER POWERS: And frequently the requirements are for accidents that never occur.

CHAIRMAN SHACK: That's not true. The way they're picked here though because they do come out of the PRA. They are --

MEMBER APOSTOLAKIS: But you look at the beginning, I think that's Graham's problem. You don't see a list of what will be required. You don't see that. I mean you go to Chapter 6 and you see some requirements and maybe later on you have other requirements. That's why I think we will never agree to anything unless we see a summary of what is required.

MEMBER KRESS: And there's a chicken and

egg question. In order to determine the licensing basis events which involve frequencies and consequences of classes of accidents, you have to have a PRA first. In order to have a PRA first, you have to have a design. But the purpose of the licensing basis event is for the designer to have something to design to.

MEMBER WALLIS: They already go together, you develop --

MEMBER CORRADINI: I think the purpose of the licensing basis event is to have the regulator have something to regulate.

MEMBER WALLIS: That's it, give him something to do.

MEMBER KRESS: So the designer will sit there and --

MEMBER APOSTOLAKIS: It's also something else. In order to do the PRA --

MEMBER KRESS: The concept would be that the designer comes forth with say, here's my licensing basis events. Here's my F-C curve that I want to use.

MEMBER APOSTOLAKIS: It's a back and forth thing.

MEMBER KRESS: It's a submission. So I don't see what the Staff is doing telling them what the F-C curve is.

CHAIRMAN SHACK: His F-C curve wont' look like their F-C curve. His F-C curve just has to be inside that F-C curve.

MEMBER ARMIJO: The Staff's F-C curve should be universal, both for the single events and for the --

MEMBER KRESS: But if it's the maximum frequency and the maximum consequence or some combination of those, coming out of the PRA sequences, how could it be universal? Those are all different for every reactor --

CHAIRMAN SHACK: They have to be inside.

MEMBER APOSTOLAKIS: Below the curve.

MEMBER CORRADINI: I guess the only thing that -- the thing that I guess I didn't think about that Dana has brought in is that we still have 10 CFR 100 or the equivalent of it. It's essentially the site criteria. So if you were to default to a totally risk-based system, you still would have --

CHAIRMAN SHACK: No, no, no, this is a new regulatory system.

MEMBER APOSTOLAKIS: This is a new rule.

CHAIRMAN SHACK: You have it in their system because they have their staircase that essentially puts --

MEMBER CORRADINI: There would be no site criteria?

CHAIRMAN SHACK: No, they have essentially the Part 100 thing built into that F-C curve. Instead of postulating it -- they put it in as a frequency kind of a thing.

MEMBER APOSTOLAKIS: The designer, if this ever becomes a rule, will take a different approach from the regulator. The designer will go back and forth because to determine the success criteria for the PRA, you need the thermal hydraulic analysis.

After you determine the success criteria, you are really very crude. You are saying if you don't have these two trains, you have failed. Well, hell, there is a whole range of things in there, but the PRA says that. So if it goes with the PRA, finds the sequences, then the Staff says we don't care how you got there. We will confirm at the end. So for this frequency range, we will pick the one with the highest consequence, determine some -- I don't remember the details, some sequence, and do a detailed calculation with best estimate codes on certainness, and so on, to confirm that you are below this --

MEMBER WALLIS: But it still has to be

integrated with that particular PRA sequence.

MEMBER APOSTOLAKIS: Yes, yes, absolutely. The frequency.

MEMBER WALLIS: All you're doing is doing a better analysis of that particular sequence.

MEMBER APOSTOLAKIS: Yes, but the designer knows that so when they develop the design they go back and forth and --

MEMBER WALLIS: They do that already.

MEMBER APOSTOLAKIS: -- but the Staff doesn't have to do that. The Staff will look at the end and say we cannot review three million sequences that the PRA produces. We will review 6, 7, 10, whatever.

MEMBER KRESS: And we'll review your calculational tool you used to determine this.

MEMBER APOSTOLAKIS: Yes.

MEMBER KRESS: Absolutely.

MEMBER APOSTOLAKIS: And you have to meet the temperature limits. You have to meet all that and the designer knows that. He has already done it.

MEMBER POWERS: George, the problem I have is the designer knows that.

MEMBER APOSTOLAKIS: Yes.

MEMBER POWERS: So we optimize a whole lot of things for the ones he knows you're going to investigate. He can say yes, I'm going to investigate in depth four or five of your accidents, but I'm not going to tell you which ones they are. I'm going to look at your PRA and decide. Then he has to do the job on all of them.

MEMBER APOSTOLAKIS: But he well -- well, he may very well have to do that.

MEMBER POWERS: The problem that we've had with design basis accidents, every context where I've encountered them is that we optimize the systems to confront that accident and forget about everything else.

MEMBER APOSTOLAKIS: Your argument is that we should tell the designer for this frequency range, we'll pick an accident we want and we will do the mechanistic calculations, is that what you're saying? Instead of picking the licensing basis accident?

MEMBER CORRADINI: He's just saying he won't say what he's going to audit, but he's going to audit something.

MEMBER APOSTOLAKIS: That's what I'm saying too. In this range, I will reserve the right to pick what I like.

CHAIRMAN SHACK: If you came in with a

design and suddenly, you know, after you pick that one and he goes back and he finds that one, you only get four choices to pick an accident and that he meets all four of those, you're okay?

MEMBER APOSTOLAKIS: But the guy still knows.

MEMBER KRESS: They are going to agree at some point on what the licenses basis events are.

MEMBER APOSTOLAKIS: But after we do it five times, we'll say to heck with it, we'll look at the highest --

CHAIRMAN SHACK: It seems to me, the current approach obviates a lot of what Dana wants because you're picking the design basis event after you do the PRA. It's not imposed a priori.

MEMBER APOSTOLAKIS: That's what the Staff wants.

CHAIRMAN SHACK: That's right. That's what I say. I think it avoids a great deal of problems that Dana sees in the design basis accident approach. Yes, if you just pick the accident sort of ahead of time, you distort the design. If you --

MEMBER APOSTOLAKIS: There are rules that will lead you to the accident.

MEMBER ABDEL-KHALIK: If you have this

freedom, imagine you start with LWR right at the beginning here, like we might with PBMR or whatever. Then you would say well, I have many ways to handle this as a designer, so instead of putting an ECC in, I'll just make an intelligence core catcher. And I'll make whatever I can to my contains. I'm sure I can cope with the core melt.

Now is that an acceptable --

MEMBER CORRADINI: Sure. According to the logic --

MEMBER ABDEL-KHALIK: According to the logic, it is. It's perfectly logical.

I think when you say that you take away all the stylized stuff you've done, I can beat finals and go to G and say I'm going to do whatever the hell to save you from --

MEMBER KRESS: You include in your framework some concept of GDCs which takes care of that.

MEMBER ABDEL-KHALIK: But that's defense-in-depth. Your core catcher is another defense.

MEMBER KRESS: The GDCs --

MEMBER APOSTOLAKIS: The deviation will still be there, but that's a good point though because --

MEMBER KRESS: You talk about the redundant ways to shut off the core. You would still maintain these kind of concepts and classes and framework.

MEMBER WALLIS: You have to have a concept that you don't want to have a core melt.

MEMBER ABDEL-KHALIK: Yes.

MEMBER WALLIS: You have to have that in there.

MEMBER ABDEL-KHALIK: Yes, but then you'd have to put that in.

MEMBER WALLIS: You have to put that in.

MEMBER KRESS: And that would be a general design criteria.

MEMBER WALLIS: I think it should be there.

MEMBER ABDEL-KHALIK: The whole thing is no longer a pure risk-based system.

MEMBER WALLIS: That's why you've got to go and say what is it you're trying to achieve. One of the things you're trying to achieve is you don't want --

MEMBER APOSTOLAKIS: It can still be risk informed --

MEMBER WALLIS: You don't want major core damage accidents.

MEMBER APOSTOLAKIS: Exactly.

MEMBER WALLIS: And that's in there.

MEMBER APOSTOLAKIS: That was part of an earlier version.

MEMBER WALLIS: Right.

MEMBER MAYNARD: There's something else I think we need to make sure that we maintain is also the ability, the stability of the regulator and also the licensee and what the requirements are.

We touched on it a little bit earlier. One of the advantages right, design basis accidents, LBEs, is that it provides clear guidance on what becomes the requirement, what comes in the tech specs, what's regulated and what's not. And I'd be all for eliminating design basis accidents if we came up with a good way to really make clear what the requirements are and maintain. I think it is wrong to have a system where hey, as long as you stay under the curve, you're okay. Because I tell you every day I can change and take systems out and do all kinds of things. And we're all going to get confused as to whether I'm in compliance or not.

And I think that's something, a lot of attention needs to be paid to before we eliminate it.

MEMBER WALLIS: That's not really considered. If you're designing a regulatory system, you've got to do this top down thing and you've got to say then what are -- how are we going to from day to day administer this? How are we going to make it happen?

That really isn't in there either.

MEMBER ABDEL-KHALIK: You know, the thing that I was saying is not that far out because that's exactly what the Canadians do. What they do is they take different consequences being allowed for different frequencies. So they allow a system to have let's say a sudden consequence if you have the emergency cooling operational and a different consequence if the emergency cooling doesn't operate. And they designed the system so that if the emergency cooling doesn't operate, it still keeps -- melts locally, but keeps a coolable geometry.

So you know, once you start to go down this route, it's not clear to me how you patch in all these things to make sure the core is coolable in this frequency range. It is going to not melt in that frequency range. It's not going to do this in that frequency range. Steam explosions in that frequency. I think it's all sorts of stuff, you know. It's frightening in some way, unless you say that all the GDCs actually are there.

MEMBER KRESS: Not all of them.

MEMBER ABDEL-KHALIK: So your core remains coolable and all this sort of stuff.

MEMBER APOSTOLAKIS: We are focusing on the curve too much, it seems to me. If you look at the diagram they have up front they show the QHOs and then you go down, they have defense-in-depth, they have tactics, they have all sorts of things.

MEMBER WALLIS: It's a means to an end. That's the performance criteria.

MEMBER APOSTOLAKIS: No, but that doesn't end with that staircase. I mean there is all this other stuff you're supposed to meet. A lot of the GDCs probably will be transferred over.

MEMBER ABDEL-KHALIK: So when you do a new design, let's say of a PBMR or a HTGR or whatever, which GDC do you transfer and which you do not?

MEMBER WALLIS: The first thing you do is you look at 1250 in the GDCs and you say which things are we going to transfer over? And you list those. That's never been done.

MEMBER KRESS: They've been doing that.

MEMBER WALLIS: That should be done.

MEMBER KRESS: They've been doing that with respect to the PBMR.

MEMBER ABDEL-KHALIK: That's an essential part to have, right?

MEMBER CORRADINI: So just to use the example of your point, I think what Sam and Dana have crafted for the letter we're eventually going to see, relative to fuel performance is performance based. If that was in force, you would have your concern alleviated because it just says thou shall keep it -- I don't know what the words you used -- I'll use the word "coolable" so that regardless of whether I have a water-based system that can melt or a gas-based system that can burn, neither is allowable to get past that in terms of fuel performance.

MEMBER KRESS: Not allowable at some level of probability.

MEMBER CORRADINI: At some level of probability.

MEMBER APOSTOLAKIS: Is prevention versus mitigation discussed in the framework, I don't remember.

MS. DROUIN: I can't remember where it is. I think it's in Chapter 6.

MEMBER APOSTOLAKIS: Because in an earlier version in 2003, you had a table that clearly had core damage frequency and condition probability of containment and the ratio was about 4 over something, so there was -- the requirement that Sam just talked about was there. Now that does not appear in the current version, but I'm wondering -- it does not appear as a table, but I'm wondering whether in the text there is some discussion of that and I don't remember now.

MEMBER WALLIS: There is. George, can I tell you where I think we are. It's clear that there's all kinds of opinions here and we're not going to write a letter which says you've got to do these things because we can't make up our minds.

What we can say is we think that this framework needs some improvement, needs some modification, something needs to happen to it and we'll work with the staff and it's going to take a year or something to do it. It's not going to happen now. It's not going to happen by one letter. It's going to happen by some serious thought over a period of time.

MEMBER POWERS: So that's why we can't rush a NUREG that's not ready to go.

MEMBER CORRADINI: So Sam got to the point that in the last half an hour --

MEMBER APOSTOLAKIS: Say that again, what is the point?

MEMBER CORRADINI: I thought the point that we're having this discussion is to give them informal feedback as they modify a report that's going to emerge.

CHAIRMAN SHACK: And also to develop our own position on what the technology neutral framework is.

MEMBER CORRADINI: Let's just talk about the first thing which is to give them informal feedback so when the report emerges it has a bit more clarity in certain places.

MEMBER APOSTOLAKIS: The only thing I can see now us recommending is don't publish the NUREG in August.

MS. DROUIN: May I give some informal feedback to the informal feedback I've heard for the last two hours?

MEMBER APOSTOLAKIS: Yes, you can.

MEMBER KRESS: Yes.

MS. DROUIN: Can I go off the record?

MEMBER KRESS: Yes. No, I don't know. Can she? Sorry.

MEMBER CORRADINI: Leave it on the record, don't worry about it.

MS. DROUIN: I'm not even sure where to start to be honest.

CHAIRMAN SHACK: Count to 10.

MS. DROUIN: I'm already up to 100. There is a gross misunderstanding what this framework document is and what it's supposed to be and what it is not. You all are looking for everything for this whole regulatory licensing structure with all of the answers in this document. It was never meant to do that.

This was a first phase of a program to get to what a regulatory structure for licensing future reactors. This was not meant to have everything. You all are looking for everything to be here. So I'm not surprised you aren't finding these things because they aren't supposed to be in it yet.

This was a document that was to provide the initial thinking, the conceptual approach, to see whether it was going to be feasible to move forward. You all are trying to get everything resolved and all of the bells and whistles into this document that was never meant to be. So that's my -- I want to put that out there.

MEMBER ARMIJO: What use is it if it's just an interim step, for purposes of review, which we're doing now, you now and maybe that's all it should be. Why publish something that really isn't going to do anything?

What are you going to do with it?

MS. DROUIN: That's a matter of debate whether it's going to do anything. That's the first step in any program.

MEMBER CORRADINI: Can I ask you a question, Mary? So just to go with that, since I don't have it, I looked for it. I only have a synopsis of it. In the preamble or executive summary, does it say literally those things you just said which is be careful, this is an initial step? This is a starting point. This has some key things on a path that will be longer than just this document?

If it says that in the preamble or executive summary, I'm on board. If it doesn't --

MS. DROUIN: The foreword has not been written yet and the foreword would say that. The initial -- I believe the forward that was drafted did say that.

I mean there are a lot of policy issues that need to be made before we can really go to things because it's fraught with policy issues that we need answers on before we can resolve a lot of this stuff.

MEMBER WALLIS: Mary, that's not the impression the document gives. The impression the document gives is that this is what you want to see happen and it's final. I mean there's no, there aren't all these cautionary statements in there.

MS. DROUIN: Well, I think they're in there. You might not have found them and they may not be clear enough, but they are in there.

You talk about that you want to see the requirements up front. We haven't written the requirements. That's not done yet.

MEMBER WALLIS: If you don't know what the requirements are, how can you design a framework?

MS. DROUIN: The framework is to help you write the requirements. It's like you want to have the requirements and then come back and say well, here's the framework of how I got there. The framework is supposed to give you the framework, the guidance for how you're going to write these requirements.

MEMBER APOSTOLAKIS: But some of the comments here are not at that level, Mary. If this document completely ignores a core damage frequency, and some people say no, that's an extremely important part, that's not just a requirement. That's a philosophical basic approach.

MS. DROUIN: I'm not arguing that point. I'm back up here with the overall general discussion that I've heard for the last two hours.

MEMBER APOSTOLAKIS: So the focus should be at that level. What is it that should be there? And if it's not, maybe we should --

MEMBER ABDEL-KHALIK: I am looking at it from a pragmatic point of view.

MEMBER APOSTOLAKIS: Everybody is trying to do that.

MEMBER ABDEL-KHALIK: I'm trying to apply this to a PBMR or whatever.

I want to know what is the minimal set of GDCs and some sort of risk-informed thingies that I can put together and actually do something with it.

I'm a designer. Let's say --

MEMBER APOSTOLAKIS: We did recommend --

MEMBER ABDEL-KHALIK: I go to the South Africans and I say look, guys, we're going to try and get this through the NRC and I want to --

MEMBER APOSTOLAKIS: Do we recommend that they do that?

MEMBER ABDEL-KHALIK: I think that is the minimum one should have in this document.

MEMBER APOSTOLAKIS: In the document itself.

MS. DROUIN: We have said on numerous -- I know we have said it at every meeting we have come to the ACRS. We've said it at every public meeting, this document is not meant for licensees. This is a document meant for staff to help the staff write the requirements. This is not a document for licensees to go out and use to design their plans with.

MEMBER WALLIS: I don't understand this. They use the framework to write the requirements. I thought the framework derived from some more basic requirements which you were trying to enforce in some way by having a framework. I don't understand this idea that requirements somehow come out of the framework. It's backwards.

MS. DROUIN: No. We were asked to come up with --

MEMBER WALLIS: We want the plant be safe and you measure the safety in various scales. That's your requirement.

MS. DROUIN: We were asked to write and develop a comparable Part 50. Well, you know, you aren't just going to go in your office and sit down at the desk and start writing it. You need some guidelines. You need some criteria to help you decide what those requirements are going to be. And this framework, we called it a framework, people can debate whether that's the use of the proper word. That's the word that we coined and we have used to say we're trying to lay out the guidance, what we would use and when you use that, that is what's going to help us provide the technical basis and the justification for developing requirements if the Commission decides yes, we do want this Part 53, whether it will be called Part 53, I don't know -- if they chose to go that route.

MEMBER POWERS: Well, I am becoming very sympathetic with Graham. I'm always sympathetic with Graham.

It seems to me that what he struggles to find is the trait study you used to arrive at the framework you defined.

MS. DROUIN: The trait study?

MEMBER POWERS: Yes. I mean you said I could go this way or I could go this way, so here are two options, presumably there are more than two. And you did something to decide ah, this is the way I'm going to go.

And he's missing that part and I think I'm missing that part too.

MS. DROUIN: I don't know how to answer that. I really honestly don't. We think it's clear. Do we think it could be improved, of course it could be improved.

We've offered to come back and meet with this Committee and --

MEMBER POWERS: The document is -- we can talk offline at some length about the document itself. It is the path that was pursued in order to arrive at the conclusion. Why didn't you adopt wholeheartedly what Tom says or adopt wholeheartedly what George says? I know why you didn't adopt wholeheartedly what I said.

(Laughter.)

MS. DROUIN: Right, and if you're looking for those answers in that document, you aren't going to find them.

MEMBER POWERS: The question is why not?

MEMBER WALLIS: It's more important than the framework itself. It's the basis for why you did what you did. That's the most important thing you can speak and describe.

MS. DROUIN: We can debate whether or not that should go into that document. I personally don't think it should go into that document. Were there discussions and a lot of thinking on that? Yes. And to be quite frank, we've had a lot of them with this Committee.

There's a lot of frustration coming out on my part because we've had a -- I hear the discussion, for example --

MEMBER WALLIS: Mary, you send it to a reviewer like me, I read this thing. I say why do they do that? I have no idea why you did that. You've got to tell me. You can't just say it was in some discussion somewhere. It's got to be clear in the document itself, otherwise, it's not convincing me of anything. It's just saying you're just describing something that you came up with. Here's a building I built. Well, it's a pyramid. Well, why isn't it an oblong or a sphere or something? You're just describing something.

MS. DROUIN: I don't know what to say, Graham.

MEMBER MAYNARD: First of all, I think this is an important subject. It's obviously generated a lot of discussion and I think it's something that is totally appropriate for the ACRS. I think we're looking at what do we do with the next generation, with new technology plants. Do we want to continue under the old system or do we want to try something new? I think it's valuable discussion. I don't believe that we're at a point with this NUREG or anything else to say hey, this is what we really should do.

Now I do believe a lot of good work has been done. I think the NUREG has got a lot of good stuff in it. I don't think it's ready for use. I think if it was put out with the right foreword and the right caveats and stuff that that may be very appropriate. If it's put out with the context of it's ready to use, then I'd say it's not ready.

I kind of hate to see the work killed. I 'd hate to see us do something that basically says let's just give up on the new technology framework. And so I'd like personally, I'd like to see us find a way to keep this moving forward.

MEMBER WALLIS: We wrote a letter last month which said the framework should be pursued. We wrote a rather fairly strong letter, clear letter, without details.

MEMBER MAYNARD: But I don't think it's

ready to issue for use. Again, with the right caveats on it, and maybe that's what's needed.

MEMBER POWERS: But Otto, do you think that somewhere, I don't know where, but somewhere, the route of which we arrive, judgments laid down, has to be delineated someplace?

MEMBER MAYNARD: I'm not sure -- I think I understand your question. I think the answer to that is yes. You're saying that we need to identify -- these are the things we reviewed. These are the options. This is why we went that way. I think it would be very beneficial.

MEMBER APOSTOLAKIS: I think though experience says that if the document is published, if they put in the foreword their caveats, do you think that the next phase, let's say they apply to the PBMR or so or whatever, are they going to go and change some of the fundamental premises and say now we're going to consider the cumulative curve that Kress wanted?

MEMBER KRESS: They probably will do that.

MEMBER APOSTOLAKIS: No, they wouldn't.

MEMBER KRESS: But they won't change the --

MEMBER APOSTOLAKIS: The NUREG is out.

The NUREG is out. That is the question, Otto, the fact as I see it is no, nobody wants to kill the effort, but is there really any urgency to publish the study in August? I mean do we have a PBMR that works to be built next January?

MEMBER ABDEL-KHALIK: Or needs to be reviewed.

MEMBER MAYNARD: I don't know if by delaying it -- the reason to publish it is to put it out for more comment.

MEMBER APOSTOLAKIS: The public has seen it. The draft NUREG is available. It's on the web. There's no need to finalize it.

MEMBER MAYNARD: By the way, I did want to support something that Mary said. My short term in dealing with this, it's been obvious to me that the intent of this NUREG was as a tool for developing the requirements for new reactors as opposed to being the definitive set of requirements for a new technology.

CHAIRMAN SHACK: It makes a big difference whether we start with the QHOs or Tom's proposal. We're still at the level where we are setting basic requirements and we haven't come --

MEMBER WALLIS: You said they're going to be LBEs like DBAs and all that -- you're already saying those are going to happen.

MEMBER ARMIJO: Or go even a step higher than that and say we're going to impose constraints on the maximum consequences of an individual accident and we're going to impose constraints on the total risk from all accidents.

That seems to be --

MEMBER WALLIS: We're going to --

MEMBER ARMIJO: The highest level --

MEMBER WALLIS: Right, the limiting frequency on major core damage events or something like that.

CHAIRMAN SHACK: Those are release event.

MEMBER WALLIS: No, it's not necessarily--

CHAIRMAN SHACK: Here, it's release. In the 2004, there was this core damage accident and that disappeared from the -- presumably because of the PBMR people who argued they didn't have such a beast.

MS. DROUIN: PBMR had no -- we did not agree with them.

CHAIRMAN SHACK: It disappeared. In 2004, you had essentially the criteria for those things and in this version it disappeared. I have both versions here.

MEMBER WALLIS: Mary, Would TMI --

CHAIRMAN SHACK: And why?

MEMBER WALLIS: Would TMI meet your framework? There's no major release.

MS. DROUIN: I am not going to get into those kind of debates here.

MEMBER WALLIS: It's important. This is a traumatic event for the industry.

MS. DROUIN: I'm not trying to be quip here, but these are questions that you know, I'm not going to give a sound byte answer to it. We have offered to come back to this Committee for another subcommittee detailed discussion. We're willing to do it. But I think trying to answer some of this in 30 seconds, I'm sorry, I don't think is right or fair.

MEMBER APOSTOLAKIS: I think there is another issue here in all honesty. It's not just the stuff. I mean first of all, the amount of material that's in the report is overwhelming. To have a meeting here a day and read it before you come still it takes time to digest.

On top of that, we have to digest what Kress is saying and then what Graham is saying.

MEMBER KRESS: It's a hard thing to stop.

MEMBER APOSTOLAKIS: And it's a natural evolution. It's not necessarily anybody's fault. It seems to me these are very important issues. You need time to digest them. And if there is no urgency, let's give ourselves -- I don't think, in other words, that meeting with the stuff again in a month will help us very much. We're trying to understand each other here.

So what we need to do is maybe take a couple of the Saturdays that are coming up and spend the whole morning just on these issues. Until we settle it among ourselves, because it's unfair to them too.

MEMBER KRESS: And just because I'm going off the Committee, putting it off -- I'm coming back as a consultant on this.

MEMBER WALLIS: I'll tell you what you do, George -- since Tom and I are going off the Committee, you can hire us at the appropriate fee to --

(Laughter.)

MEMBER ABDEL-KHALIK: Now that is a sensible idea.

MEMBER APOSTOLAKIS: But then we will be able to tell you to keep silent.

MEMBER MAYNARD: I think we can decide on an appropriate fee.

MEMBER APOSTOLAKIS: No, really. I don't

think the issue in front of us will be absorbed by a meeting with the Staff.

MEMBER MAYNARD: Right.

MEMBER KRESS: We have to agree among ourselves first. Argue these things out.

MEMBER ABDEL-KHALIK: I think there's a wide divergence even in our philosophies.

MEMBER APOSTOLAKIS: I think it's more than that. I don't think we really understand each other.

MEMBER ABDEL-KHALIK: Maybe if we do, we are divergent in the say we look at things.

MEMBER APOSTOLAKIS: Yes.

MEMBER ABDEL-KHALIK: And we have to come to some meeting of minds.

CHAIRMAN SHACK: We didn't make much progress today.

(Laughter.)

MEMBER CORRADINI: You got one circle here.

Let's not fall back on that.

MEMBER KRESS: And, of course, Said made a couple of really good points, I thought, to clarify.

MEMBER APOSTOLAKIS: So is there a Saturday in the future that would be free of anything else?

MEMBER WALLIS: How long on a Saturday would you want, the whole day?

MEMBER APOSTOLAKIS: The morning, the morning. The standard thing. But --

CHAIRMAN SHACK: This Saturday might be free.

MEMBER APOSTOLAKIS: Okay, so let's finish all the letters tomorrow, don't raise any questions about my letter.

(Laughter.)

MEMBER ABDEL-KHALIK: That's a quick way to get this letter through.

MEMBER APOSTOLAKIS: And then on Saturday we will come together. I really would like --

MEMBER WALLIS: I think, George, you need to digest some of this stuff too, and think about it. Not just you, everybody. The spontaneous discussion needs -- we need to come with some thoughts that are written down and really worked out.

MEMBER APOSTOLAKIS: That's right. That's right. That's what's happening.

MEMBER WALLIS: I'm not sure that something we have on Saturday like we have today is going to help anything.

MEMBER APOSTOLAKIS: Maybe we can start by having Dr. Kress give a more formal presentation.

MEMBER KRESS: I would love to do that.

MEMBER APOSTOLAKIS: I'm willing to listen.

MEMBER POWERS: I would like to understand if you, Dr. Kress, consider Graham's argument, the trait study character appropriate or not.

MEMBER KRESS: I think it's generally appropriate to decide on what your trait study options are going to be, pros and cons of them. I think they did that internally without really calling it that and decided that this is an appropriate way to go and has attributes in it they like.

I think it was implicit in their thinking. I don't think they actually went down and said we could do this, this, this and what are the pros and cons of that.

I don't think you can always do that because there aren't many options for the way they could go here. If you're going to have a risk-informed system as opposed to completely risk based. I don't think -- I can only think about three options on how to go about doing that and I don't know -- what I'm trying to say is I think it should be implicit in your thinking, but as far as putting it down as pros and cons, I don't think it's necessary here. I do think it would be a good idea to say why it is, what it is about this, this, this and this concept, why we chose those. The one part of the trait study, why we picked these particular concepts. And they tended to do that. It was scattered out through the report.

MEMBER POWERS: The report itself is incredibly wordy and repetitive.

MEMBER KRESS: Yes.

MEMBER POWERS: And it's very difficult to read.

MEMBER KRESS: I agree with that. I don't tell them how to write their report. I'm just interested in concepts.

MEMBER POWERS: It's helps to understand it though. The problem you get into --

MEMBER KRESS: It's appropriate to help them out on that, but as far as I'm concerned, I want to get the concepts right first.

MEMBER WALLIS: Let me say, they start saying off the -- the only thing that they say is the real criterion is the QHOs. Now the rest is all discursive and strategy and stuff.

If you only need to meet the QHOs, then

you need to say each future reactor has to meet the QHOs, period. Then what do we need to do to ensure that they do that and you base everything on that. That's not what they've done at all.

Is that what they intend to do? Is that the only criterion, really?

MEMBER KRESS: No, because --

MEMBER WALLIS: It isn't because they start losing their way.

MEMBER KRESS: L-C curve also.

MEMBER APOSTOLAKIS: I think you are a bit unfair. They have a whole chapter with a diagram that goes down and tells you you have to worry about defense-in-depth. There are strategies that are --

MEMBER WALLIS: That's all discursive.

MEMBER APOSTOLAKIS: Don't dismiss that.

MEMBER WALLIS: That's all discursive stuff.

Strategies are means to an end. They're not an end to themselves.

MEMBER APOSTOLAKIS: Yes, but they explain to you why they want defense-in-depth. What else do you want them to do? Be more explicit or what/

MEMBER ABDEL-KHALIK: It meets certain safety goals, right? I mean whatever strategy you employ.

MEMBER APOSTOLAKIS: It cannot just be quantitative.

MEMBER CORRADINI: I think there's more there than the QHO.

MEMBER APOSTOLAKIS: It's also the qualitative part which is extremely important.

MEMBER CORRADINI: So I'm back to what are we going to do on Saturday?

MEMBER APOSTOLAKIS: Let's finish the letters first.

CHAIRMAN SHACK: Let's finish the letters, then we'll figure out.

MEMBER WALLIS: Yes, let's do George's letter.

CHAIRMAN SHACK: I think the next thing would be, perhaps to have Tom, since he has a position.

MEMBER KRESS: I would like to give a much better exposition on what my position is.

MEMBER APOSTOLAKIS: Tell us what is being done now that you object to and --

MEMBER KRESS: And why.

MEMBER APOSTOLAKIS: I would like to see that.

MEMBER KRESS: I can certainly do that. I don't know if I can do it on Saturday.

MEMBER APOSTOLAKIS: Oh, Tom, you can do it in two minutes.

MEMBER KRESS: Okay, I'll do it Saturday, without slides. Okay.

MEMBER APOSTOLAKIS: Or you can draw what you like.

MEMBER ABDEL-KHALIK: Tom, can you treat the philosophical phases for this because somehow I think that's very important.

MEMBER KRESS: I sent you guys an email on the philosophical basis for my thinking and it's pretty much still my philosophical basis. You read that. It's pretty much complete in terms of why I think --

MEMBER APOSTOLAKIS: It's nice to hear you speak. It's very nice.

MEMBER ABDEL-KHALIK: For the last month I haven't read anything.

MEMBER WALLIS: It was very nice in that he put the basic high-level requirements first. He said you've got to be clear about those.

MEMBER KRESS: Yes, and I was very clear about what they are and why and some rationale behind it. But I'll be glad to go over it on Saturday.

CHAIRMAN SHACK: One of my problems is I think you're dead with the Commission at your first level. I mean they have consistently said that the QHOs are good enough.

MEMBER KRESS: I'm still saying the QHOs are good enough. They haven't said they were good enough for a specific incident at a plant.

MEMBER APOSTOLAKIS: They didn't --

MEMBER KRESS: I don't think they've ever said that. They said that's good enough for a design -- for our safety goals. And I'm saying sure they're good enough, even though they don't address societal risks. You've got to address societal risks some way and right now it's done with some population. But I'm not disagreeing with the QHOs. I'm saying that's the overall risk objective.

CHAIRMAN SHACK: No, but then you impose on an individual design far more stringent limits.

MEMBER KRESS: That's right, because you don't impose QHOs on a design . That's where I think you're wrong.

MEMBER POWERS: I personally cannot understand how you would apply the QHOs to a design and second of all, how you even evaluate how a plant on a site meets the QHOs.

MEMBER KRESS: I'm at a loss to explain that because I don't understand it either.

MEMBER ABDEL-KHALIK: That's Tom's point.

MEMBER KRESS: What the concept there is the QHOs are to apply to an individual plant's risk on a site and they use some sort of representative site and say all right, calculate the doses due to this design and if it meets the QHOs, fine. That's a concept. What that fails to do is say that the site itself is going to meet the QHOs which is really what I think the safety goals were intended for. So it goes against the current safety goal and the safety goal guidance in my mind.

Even though the safety goals were never meant to be applied other than as a gauge for how good we're doing in regulations, but we're in a different venue now and a different level.

MEMBER CORRADINI: Just so I understand Dana's comments because I thought I was going to agree with him except the way you interpret them. What I thought he just said was is that if I had the QHO, and I then had a plant at a site, the comparison of the two would be difficult unless I did some sort of connecting calculation that says what is the societal risk, what is the risk on early fatalities and all of that in that region. You're going to need something in between or a calculation in between to do the comparison.

MEMBER KRESS: You have to have a site description. And what you do is you use some sort of representative site.

MEMBER CORRADINI: With a representative population.

MEMBER KRESS: Absolutely. And maybe you bound a little bit, but that's the way you do it. Or you --

MEMBER POWERS: Suppose I'm going to put a reactor on the Clinton site in the great State of Illinois, wind blowing presumably toward Chicago some place and you sit down and calculate the QHO, you calculate the risk in comparison to QHOs. How would I do it?

MEMBER CORRADINI: That's what I was trying to say.

MEMBER KRESS: You do a full -- do you have a plant there?

You have a plant and a PRA there? You calculate it out to 50 miles, the cancers?

MEMBER POWERS: There's an internal events

PRA.

You might have a seismic hazard analysis.

MEMBER KRESS: I completely agree with you on this, Dana, that the PRA and the calculation of the QHOs have to include all the risk including seismic and external events and internal events and shut down. I agree with you completely and I think you're right in saying we don't really know how to do that and we don't it properly -- and in my mind, you ought to have uncertainty in that also. Because QHOs are talking about means and in order to get a mean I think you have to have uncertainty distribution.

I agree with you, I don't know how to do it, but I'm looking at conceptual things and I'm hoping that once we get the concept down and say oh, in order to meet these conceptual regulations, we have to have a PRA that's this quality that includes seismic and shut down and --

MEMBER APOSTOLAKIS: I think the Commission has already decided it will be Level 1 and Level 2, haven't they?

MEMBER KRESS: I think --

MEMBER APOSTOLAKIS: Part 52 says Level 1 and Level 2, I believe.

CHAIRMAN SHACK: Yes, and you get your

curie release by going to the QHOs, going to some representative site, figuring out what the curie release and then dividing by 10. It's as artificial as any other --

MEMBER KRESS: And I agree you can do that. I'm just saying --

CHAIRMAN SHACK: I'm not sure it's any better or any more design oriented than picking a generic site and sticking with the current requirements. I mean you end up with an artificial sort of thing anyway, aside from the fact that you stuck an extra order of magnitude on it.

MEMBER KRESS: I think it's just the wrong way to design a reactor. In principle, you should not apply site characteristics to individual plants, you just should not do that. That's basically a bad approach to design in my mind. And that's what I'm saying. Don't do something that's bad and requires you to do all these things that are somewhat artificial.

CHAIRMAN SHACK: As I said before, it forces you to think about all the things that are associated with the site, even if you're dealing with a generic site.

MEMBER KRESS: What I'm saying is you

already thought about that when you impose a CDF and a LERF. You've already thought about that. That was the basis of my philosophy. You have already thought about that and that's where I come up with the numbers of 10^{-5} and 10^{-6}, because that's exactly where I got them from. I thought about this.

MEMBER CORRADINI: But they arrived at it, Tom, in the reverse direction, at least I would have thought that. They derived the CDF from the fact that nobody argued with WASH-1400 that it should be 10^{-4} and they just added an order of magnitude and nobody argued the fact that they could potentially show containment performance of an order of magnitude, so they divided it by 10 again. So they worked in the foreword direction and all of these things are working in the backward direction and all of them involve more and more calculation.

MEMBER KRESS: It doesn't matter which direction you go in.

MEMBER CORRADINI: In my mind, the foreword direction I have more certainty on what the numbers might be. The backward direction is a lot of -- so what you're saying --

MEMBER KRESS: What I'm saying is the level of design safety as described by a CDF and a

LERF or the equivalent FCCCDF is a policy issue.

MEMBER CORRADINI: See, where I'm agreeing with you --

MEMBER KRESS: It's strictly a policy issue. Now I'm saying I think the policy ought to be 10^{-5} and 10^{-6}. Somebody else may have a different policy. The Commission may want a different policy.

MEMBER CORRADINI: Not to drag this out, but just from the standpoint of clarification, I guess what I'm saying is I'm with you where you're taking a core damage frequency and a large release and saying okay, I'm going to take that and get a stylized curve that represents that on a shape. I'm okay there. Right? I'm not sure if I'm with you about site versus design certification, but leaving that aside, once I have that stylized curve, I'm with you there.

Where I think though --

MEMBER KRESS: Single plant.

MEMBER CORRADINI: For a single plant. Where I think --

MEMBER KRESS: It doesn't have anything to do with the site except complicit.

MEMBER CORRADINI: Right, where I think Dana was bringing something up which makes what you're saying to drive it to a curve relatively conservative although maybe that's where I want to go when I have a lot of plants on the site is if I include everything beyond internal events, the wiggle room out here on this part of the curve is very big because there's a lot of things I don't know how to calculate. And so you're saying too bad, that's it and you've got to show it all fits inside the boundary and if you can't figure out or calculate it, go do more work and figure it out --

MEMBER KRESS: Will you tell me what else you would do? What would you do instead? The criteria is a site risk.

MEMBER CORRADINI: Okay, again, I'm not disagreeing yet, I'm just -- I'm walking through in my mind all the things that that implies. And if I did a 10 CFR 50 approach right now, it leaves all that wiggle room to judgment. It doesn't put it in the regulation.

That's where I understand --

MEMBER KRESS: Unless you have a CDF and a LERF in your rules which we kind of implicitly have. They're not --

MEMBER CORRADINI: Yes, we do, but for the --

MEMBER KRESS: Well, in Part 50 we do.

MEMBER CORRADINI: Right.

MEMBER KRESS: We say you have to look at it.

MEMBER CORRADINI: Right.

MEMBER KRESS: They don't say what it has to be.

MEMBER CORRADINI: But I guess what I'm saying is if I work out from the standpoint of what we're doing now and create a curve for it, a cumulative curve, I'm with you. I represent I'm with you. But now as I get and I start including all these external events to what I understood Dana's point was is that now you're going to have a real problem in getting a lot of these estimates and if I put it in the regulation base, then I'm going to have --

MEMBER KRESS: I'm not saying it's not a problem to calculate it, but if it's the right thing to do, I mean are we going to have -- are we going to protect the health and safety of the public by having a risk criteria? We've already got QHOs and they're -- they have the same issue with QHOs. It doesn't matter whether it's my curve or QHOs.

MEMBER CORRADINI: That's where I have the problem with the QHOs. I actually understand yours by working out from the numbers that people are using now as a practical way to provide safety.

MEMBER KRESS: Well, they calculate the F-C curve for all the current reactors. Every time they do a PRA, it's kicked right out. It's calculated. And the only trouble with it there, except I agree with Dana that this is almost always for internal events and they use some other way to screen out seismic and fires usually and say they're not contributing much to this is the way to deal with the amount. I don't think they can always do that. If you get down to the magnitude I'm talking about, then you can no longer screen out seismic because it's problem may be the dominant one. You end up with a different issue there, but I'm saying you have to deal with it. If that's the dominant risk, then you've got to deal with it.

CHAIRMAN SHACK: We better stop here. We need to get on with the letters. Let's take a 10-minute break for everybody to recharge here.

(Off the record.)