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NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

SAFETY RESEARCH PROGRAM SUBCOMMITTEE

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WEDNESDAY,

MAY 2, 2007

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The meeting was convened in Room T-2B3 of Two White Flint North, 11545 Rockville Pike, Rockville, Maryland, at 10:30 a.m., Dr. Dana A. Powers, Chairman, presiding.

MEMBERS PRESENT:

DANA A. POWERS	Chairman
GRAHAM B. WALLIS	ACRS Member
MICHAEL CORRADINI	ACRS Member
SANJOY BANERJEE	ACRS Member
SAID ABDEL-KHALIK	ACRS Member
J. SAM ARMIJO	ACRS Member
WILLIAM J. SHACK	ACRS Member
GEORGE E. APOSTOLAKIS	ACRS Member

NRC STAFF PRESENT:

BRIAN SHERON

CHRISTIANA LUI

NATHAN SIU

ROB TREGONING

DON HELTON

STEVE ARNDT

STU RUBIN

CHARLIE TINKLER

JOCELYN MITCHELL

TOM NICHOLSON

PRASSAD KADAMBI

A G E N D A

OPENING REMARKS AND OBJECTIVES 3
D. Powers, ACRS
DEVELOPMENT OF AN INTEGRATED, LONG-TERM
REGULATORY RESEARCH PLAN 13
C. Lui, RES
LUNCH 68
CANDIDATE LONG-TERM RESEARCH ACTIVITIES 71
R. Tregoning, RES
D. Helton, RES
N. Siu, RES
BREAK
DISCUSSION 201
ADJOURN

P R O C E E D I N G S

(10:30:16 a.m.)

CHAIRMAN POWERS: The meeting will now come to order. This is a meeting of the ACRS Subcommittee on Safety Research Program. I'm Dana Powers, Chairman for this subcommittee meeting. Members in attendance are Said Abdel-Khalik, Sam Armijo, Graham Wallis, Bill Shack. Professor Corradini may join us in the afternoon, if he so deems.

The purpose of this meeting is to discuss the status of staff's effort associated with the development of an integrated, long-term regulatory research plan. The subcommittee will gather information, analyze relevant issues and facts, and formulate proposed positions and actions, as appropriate, for deliberation by the Full Committee.

Dr. Hossein Nourbaksh is the Designated Federal Official for this meeting. The rules for participating in today's meeting have been announced as part of the notice of this meeting previously published in the "Federal Register" on April 17th, 2007.

A transcript of the meeting is being kept and will be made available, as stated in the "Federal

Register" notice. It is requested that speakers first identify themselves, use one of the microphones, and speak with sufficient clarity and volume so they can be readily heard. We have received no written comments or requests for time to make oral statements from the members of the public regarding today's meeting.

I will remind the members that this issue of long-term regulatory research is actually one that the Commission put on us, and that we have agreed with the Commission to address this in our semi-annual or bi-annual research report, but the staff has moved out aggressively on this, and is looking for some feedback from us early, and continuing in this operation. This is something that they intend to keep doing, and revisiting as time goes on. And this is as good an excuse for us to start thinking about this, as any I can think of.

Do any of the members have opening comments they would care to make? Seeing none, I'll turn to you, Brian for opening comments.

MR. SHERON: Thanks, Dana. We're really glad to have this opportunity to meet with the subcommittee. I think we -- I know that -- I talked to Dana, I said I know the Commission had asked the

committee to look into this area. I think this is an ideal time, an opportune time for the committee to provide us with any input, any observations, any suggestions that you all have.

CHAIRMAN POWERS: If I might just interject, Brian, the last two research reports the committee has written have complained that research, too much of the research sources had been focused on the close support of the regulatory process. I mean, the research should always support the regulatory process, but always supporting the day-to-day things that you need to look longer term. And, quite frankly, the Commission called our bluff on this and said okay, what.

MR. SHERON: I think as we get into the discussion, you'll see a lot of it is really, in my mind, has to do just with the resources that are available, and how one allocates them.

The work we're doing - Chris gave me a script, but I'm going to deviate here. I do want to point out, though, that Chris is our lead SES Manager that I asked her to take a break from her position. We had some individuals that are in the SES Candidate Development Program, and I said this was a great opportunity for them to --

CHAIRMAN POWERS: This is, by the way, a very dangerous thing. When your managers start telling you that this is a great opportunity, you want to see - develop some need for leave or something like this.

MR. SHERON: No, but I did recognize that this was something that the Commission has a very strong interest in, that I wanted somebody to put, basically, full-time attention to it, so I asked Chris to step out of her normal position and lead this effort for the past several months.

Nathan Sui, Rob Tregoning, and Don Helton are all up here, I think provided valuable support, as well as the rest of the research staff. We did not exclude. I went out with an office-wide announcement requesting the staff to provide their ideas to Chris and her team. And they had to kind of digest all that, and figure out what makes sense, what we could do, what we couldn't, and the like. But the intent was to try and get as broad a thinking as we could from the staff.

This came about - right after the Chairman first came here, I have periodics with the commissioners, and the Chairman asked me what our long-range research plan was. And, of course, I said

well, we have -- we look out three years to our budget cycle. And he went no, no, no. He says, you know, where do you want to be 5, 10, 15 years from now? And I was kind of taken aback by it, and I said, well, we really hadn't thought out that far. And the Chairman is very much a strategic thinker, I guess that's the best way I can describe him, and he feels that we should be looking to where we need to be in the long-term, and really what are the tools that this agency is going to need in order to meet the regulatory challenges out in that longer time frame. And that's really what he challenged us to do, was to say where do we need to be, what do we need to do to position ourselves so that we will be ready to meet the challenges that we expect we'll be faced with as a regulatory agency in 5, 10, 15 years from now. And so that was sort of what my charge was on this. And so, as I said, we went through trying to identify what the candidates are. We had discussions with DOE, not necessarily related to this report, but in terms of cooperative research, looking down the road.

When we looked at these, we recognized that there's some work that we're doing that may be considered long-term, but it's pretty well defined; for example, our Advanced Reactor Research Plan, so we

did not include the kind of work that we're doing right now, even though it may be longer range, but for which we have a separate plan for, and it's been identified. So what this plan really does is, it tries to look out beyond where we are, where we think that we're going, for example, with the advanced reactors, with the new reactors, and the like.

We have to be careful. We don't want to get into what I would call playing in the sand box, which is looking at things that may not really have any value. Some of the work that we're proposing is more exploratory in the sense that we would be putting out, I call it contracts, for people, and I'm hoping its universities, perhaps commercial organizations, as well as labs to just take a look and say where is the industry going, and where is this technology going? Is there an application to nuclear that might be something that we want to look at?

I think some of these may be a dead end. We may decide that there's really nothing we can do at this time, or should do. And others, we may want to pursue even further. I think you'll hear about what we call life beyond 60. What are the technical issues that plants have to deal with, if they want to operate beyond 60 years?

And the work we're proposing doesn't necessarily mean that it's stuff that NRC has to do. A lot of it may be, this is work that the industry probably needs to pick up on, and start doing now. And I think it would be good if we identified that to the industry as early as we can. And then we can decide what work the NRC needs to do to fulfill our mandate as independent confirmatory-type of work.

So with that, if you have any questions of me about the overall - otherwise, I'll turn it to Chris.

CHAIRMAN POWERS: Let me ask this question, Brian. In our previous research report, we raised, essentially, the same question, and attempted, perhaps inarticulately, and certainly incompletely, to portray a vision that we had, which dealt with things like the computational capabilities the NRR staff would have, like at your desk PRA analyses, at your desk thermal hydraulic analyses, at your desk resources on a variety of things that arise in the regulatory process. Did that vision enter into any of the thinking here?

MR. SHERON: Well, we went to the other offices within the agency. I'm going to let Chris and her team talk about it more, but we went to them and

asked them what they envisioned as long-term research needs. Okay? So to the extent that that was articulated, I think Chris can talk a little bit more about the detailed interactions.

One thing I did want to point out, I didn't mention, and that is that in putting together this plan, one of the -- there's a couple of issues you just need to be aware of. One is that the NRC, as you know, has a common prioritization scheme.

CHAIRMAN POWERS: Right.

MR. SHERON: And Chris will probably talk about this, but, obviously, when you start looking at long-term research where you can't identify a direct regulatory use at this time, when you put it up against the criteria for -- against, say, other work that may have more immediate or short-term need. Okay? Obviously, this is not going to fare very well. And so one of the things we're struggling with is whether or not this needs to be pulled out of that ranking process, or whether there needs to be additional criteria in there.

CHAIRMAN POWERS: One of the challenges that we think research faces in any time it formulates some of these strategies is, in fact, the concurrence process. I mean, I think the -- it seems to me to be

fair to say some fraction of research's budget ought to be done -- has to be done by research, in consultation with its own conscience, and not with people with applied needs, because sometimes innovation is just not going to be the product --

MR. SHERON: That's -- I have no problem with that. I do have a difficulty if you start assigning specific percentages and the like.

CHAIRMAN POWERS: Yes.

MR. SHERON: And I think what we really need to do is look at it from the standpoint of more on the merits of the individual projects. Okay?

The other thing, which I think the Commission is supportive of, and that is that -- and we did, we identified this in our `09 budget request, and that is that we identified additional resources just to do this work, so it's not like we're saying that in order to do this work, I'm not going to be able to provide, say, NRR with a computer code, or NRO with this type of tool, or we're not going to do this research on sumps or something. Okay?

We've identified additional resources that we believe would cover this work, and does not affect our ability to do the work that the user offices are asking us to do.

Unless there's any other questions, I'll turn it over to Chris.

DR. ARMIJO: I have a general question.

MR. SHERON: Yes.

DR. ARMIJO: How does this new work fit with the existing work from a standpoint of budget? Does the existing work, does it have certain closure points, and freeing up of resources that would be applied to this new work? How does this all fit together, the existing R&D program, and the future long-term? Is one a delta on top of what's going on right now?

MR. SHERON: Yes. We identified in the `09 budget, which is where we are in the request process right now, is formulating that; $5.5 million and I think it was $8.1 -- is that right, Chris?

MS. LUI: Correct.

MR. SHERON: Over and above. This is additional resources specifically that we would devote to this effort. That's over and above what we had already identified what was needed to meet our budget and regulatory obligations, if you want to call it that, for the existing plants and new reactors.

DR. ARMIJO: Okay. So this 5.5 is over a how many year period, or is that an annual?

MR. SHERON: That's annual.

DR. ARMIJO: That's an annual. And the base is what's the actual --

MR. SHERON: For `09, I think it's 70 -- well, I think we'd have to subtract out the 5.5, so it's about $73 million.

DR. ARMIJO: Okay. Thanks.

DR. WALLIS: This money is not billable to anybody. It comes from the U.S. government, does it?

MR. SHERON: Well, one of the questions that the Chairman has raised is whether or not this needs to be included, or taken out of the fee base. Right now, this would be in the fee base.

CHAIRMAN POWERS: But that is not an issue that this committee will address.

MR. SHERON: Right. This is the one the Commission has asked us to --

CHAIRMAN POWERS: That's their business, and not our's.

MR. SHERON: Yes.

CHAIRMAN POWERS: Christiana, it's up to you now.

MS. LUI: Okay. All right. Good morning. My name is Christiana Lui, and I'm the Deputy Director of New Reactors and the Computational Analysis, as

Brian has indicated, that I was asked to step out of my regular job and take the lead to put this particular document together. Supporting me, we have an office-wide team, we have Rob Tregoning, the Senior Level advisor from Materials, and Nathan Siu, the Senior Level advisor for Probabilistic Risk Analysis, and Don Helton, as a Reactor Systems Engineer supporting me to put this together.

And like Brian has indicated, that we are trying to -- doing the Step One of the process, which I will describe in a little bit more detail. We have attempted to involve the whole agency in putting this together, so this is truly a reflection of an agency-wide effort at this point in time.

And for the rest of this morning, I'm going to be on the formal presentation by providing you an overview and status regarding where we stand, and the product that has come out. And these documents, Rob, Nathan, and Don, all those technical topics identified in the plan.

The purpose for the meeting today, as I have described earlier, is to really provide you the process, and also the outcome. And also, we want to highlight a process for updating this long-term research plan, as Brian has alluded to, that we intend

to keep this as a living document. We will summarize the proposed FY `09 activity, and clearly, we would like to solicit your view regarding your level of involvement, your engagement, and also, your recommendations for going forward.

Just go through the background in a little bit more detail, as Brian has indicated, that this, in his periodic with the Chairman, the Chairman was very interested in looking at what we're doing in this particular in terms of research. And, in fact, there is a Staff Requirement Memorandum based on the FY `08 budget deliberation that the Commission wants the staff to focus on, forward-looking regulatory research. And in addition to that --

(Static.)

CHAIRMAN POWERS: Proceed, please.

MS. LUI: When we presented to the Commission during our annual Office of Nuclear Regulatory Research Program briefing, the long-term research was a pretty heated discussion topic among the commissioners, so we continue to show -- we continue to demonstrate the Commission, as a whole, has interest in this particular area.

Just want to go through the objectives and scope for the current document in a little bit more

detail. We attempted to produce an agency-wide document by engaging the other program offices, and during the months of December and February, we had numerous meetings with the other program offices' point of contact. We also passed around the document for concurrence by the other program offices. We listened to their input, and views, and we consolidated everything together to present to management for consideration.

The focus of this document is on long-term research needs. Our starting point is FY `09, so anything that's prior to FY `09 is outside of the scope. The other highlight I want to point out is, in order not to duplicate the other efforts, this particular document focused identifying new forward-looking and long-term research. The other work that's documented elsewhere, as Brian has indicated, the advanced reactor infrastructure assessments, since it is a separate document, we did not attempt to go into - address any of the reactor work in this particular plan, except in one area, that we will discuss with you this afternoon.

And because we have a lot of other agency planning documents, such as the Operating Plan, all the current work that's already documented in other

places, they are outside the scope of this particular plan. So just want to make sure you understand we are -- we want to be comprehensive, and at the same time, we want to carve out a particular role for this particular report.

DR. ABDEL-KHALIK: Wouldn't it make more sense sometime to integrate all these long-term research activities into one document, so that a person looking at an integrated, overall research plan would understand where all the pieces fit together?

MS. LUI: Yes. In fact, that's one of the Lessons Learned, we'd like to share with you a couple of slides from now, some of the thought process that have gone into that. Yes, that was actually one place that we have gone, and both due to the resource constraint, and time constraint, we decided that since all this other work has been documented elsewhere, the role of this particular report at this particular time, we were focused on what's new and different.

DR. ABDEL-KHALIK: But eventually you would integrate all these documents into one coherent plan?

MS. LUI: That would be a logic place to go, and at the same time, that will also require resource requirement. In other words, to integrate

everything together, that means we need to dedicate resources, a set of resources into everything, and pull everything together, so that's something that we need to work with a much larger group within the agency looking at the different roles and responsibilities of all the various agency planning documents, and decide what would be the most comprehensive approach. So that's going to require some thought.

DR. ABDEL-KHALIK: I mean, it would seem that that ought to be set somehow to have one consistent, coherent plan that combines all these pieces together, aside from the fact that you do require resources to do that.

MS. LUI: Yes, we agree. And, also, the other issues that we have contemplated -- when I get to the Lessons Learned slide, we will definitely discuss that in more detail.

MR. TREGONING: There are trade-offs in one big plan, and it ends up being a very large plan, that it would be --

(Static.)

MR. TREGONING: Try again.

CHAIRMAN POWERS: I think we can progress ahead, now.

MR. TREGONING: This is Rob Tregoning -- it must be me.

CHAIRMAN POWERS: It jumps in, yes.

COURT REPORTER: Try it now.

MR. TREGONING: Rob Tregoning, Office of Research. The only point I wanted to make with regard to your comment, it's certainly a logical comment, and actually something that we looked at. The thing that we struggled with, we actually put together a first draft of a document that was very integrated, and it had everything, by and large, that we were doing.

The problem was, it becomes such a large document, and the new aspects were becoming lost, so that when people were reading the document, it wasn't clear what the new things were, what new areas we really needed to be focused on. In fact, some of the comments that we got back were, from the people that were familiar with the research that we do, is that it read more of same old, same old. This is the normal course of business that NRC does, so that's why we made the decision at one point in the process that we really needed this stand-alone document to focus on the new things.

As Christiana mentioned, going forward, though, there are opportunities to revisit that

decision, and look at some possible advantages to providing a single plan, but at least at this point in time, it just didn't make sense. We didn't think it addressed what the Commission really was looking for, to try to identify areas that we really need to go in, that are different than maybe we've been heavily involved with in the past.

MR. SIU: Nathan Siu, here. We also thought about, and I think Chris will get to this, different communications tools. You might have a big plan that has everything, but then you pull out stuff that satisfies particular needs, because we certainly had a particular use in mind when we were generating this particular plan. And, hopefully, it's met the needs of that use, but for other applications, other decisions, when you want to consider what's everything going on, and how much of this is long-term, if you want to balance the long-term versus the near-term - yes, an integrated plan would make a lot of sense. Thank you.

MS. LUI: Yes. I'm glad that Nathan actually mentioned about the communication tool and level of detail. The reason that we -- the focus of this particular effort is to produce a relatively high-level description in order to support the budget

planning process for FY `09. And since we are on this particular topic, we might as well start talking about it in a little bit more detail.

When we were looking at the other research plan, as Rob has indicated, that we did have the draft report that tried to pull together a lot of information from the various pieces of the other planning documents. We found out that the level of detail for all these different planning documents were at different level, so it would depend on who's the intended audience, and what's the use of the final - this integrated plan that you envision, it can be written at many different levels, many different levels of detail. And for the purpose of this document, we were -- our audience is the Commission, and ultimately, could be somebody who would be determining the budget for the agency. So it's being written at a relatively high-level, so that was the purpose for this document. That's the reason why I have implied that it will depend on what we are looking for, there would be resource implementation. And, also, the coherence of that system, the plan, regarding whether the agency really wants to go that route.

DR. ABDEL-KHALIK: Yes. A high-level,

integrated document would be very valuable, because somebody looking at this without knowing the details of what else is going on would say is that all you're looking at? And that would sort of bring into question the value, and coherence, completeness of whatever you're proposing here.

I'm not suggesting a complete detailed document describing each and every project and sub-project that you have, but a high-level document that would integrate all the long-term activities would be very valuable.

MS. LUI: Okay. Thank you for your recommendation. And as we have talked about, we intend to keep this as a living document, and update it periodically, so the type of document that you envision - there is opportunity, that it may not be for the FY `09 report, but in the future, there will be opportunity for us to have a little bit longer time, and, also, a low-level continuous level of effort to put that together.

During step one of the process, Office of Nuclear Regulatory Research took the lead, and the whole effort started in December 2006. And we generated ideas from a variety of internal sources. We have engaged the staff in the Office of Research,

as Brian has indicated. We sent out, solicit information to all the research staff, and we also worked closely with the other program offices describing to them what was the objective.

DR. WALLIS: You have a big list of sources here, but the list of topics is rather small.

MS. LUI: Correct, because we did --

DR. WALLIS: So I assume that some of these groups had no suggestions at all.

MS. LUI: The other program offices did come forward, and a lot of the suggestions actually, really targeted at resolving existing regulatory issues, still near-term work.

DR. WALLIS: Okay. So many of the suggestions were not suitable for a long-term --

MS. LUI: Correct. And, in fact, a lot of the suggestions that have come forward, have been taken into consideration for the FY `08 budget planning cycle. Therefore, yes, many ideas came forward, and a fair amount of them actually got incorporated into the FY `08 budget, because it's just the timing, since we were just right in the middle of doing our FY `09 budget, and restacking our FY `08 budget, so we had the opportunity to looking at a suggestion that came forward.

DR. ARMIJO: As far as inputs from industry, did you solicit specifically inputs from industry, or is their input based on your assessment of what prior discussions you'd had in years before?

MS. LUI: The latter case.

DR. ARMIJO: Did you go to EPRI or NEI and ask them hey, we're thinking of a long-term plan. Where are you guys going with your long-term R&D?

MR. SHERON: That's actually the next phase.

DR. ARMIJO: That's the next phase.

MS. LUI: That's step two of the process. That's the process that we're in right now.

DR. ARMIJO: Okay.

MS. LUI: And doing step one, which concluded by March time frame, we did not go out to industry formally, simply because of a time constraint at that particular point in time.

DR. ARMIJO: Okay.

MS. LUI: So we have staggered this as a two-step approach, and step two, that's the step we're in right now, we will be soliciting input from the industry formally.

DR. ARMIJO: Okay. Because the time line - and I read some of your documents - the time line is

you've got to go to the Commission some time in June or July with final things.

MS. LUI: July.

DR. ARMIJO: And the Commission wrote this SRM back in August. They talked to the ACRS, and asked our input in October of last year, and here we are in April, we'll see it for the first time. And in July, between now and July you'll get industry and other people to specifically -- it seems like the external input to this thing is going to be rushed, and not particularly well thought out. It seems like you could have started earlier getting these inputs. You could have thrown all their inputs away, but --

MR. SHERON: Let me address that. When the Chairman asked us to look into this, he actually was thinking about producing something in a very short period of time. And it was shorter than even what we had envisioned. And we took a hard look at the schedule that we could meet, and we said that in order to put together a report - remember, these things - when you go up to the Commission, they've got to go through internal concurrence. When you start backing up from when you want to get something to the Commission, and you look at the time it's going to be in EDO's office, within office concurrence - okay,

Chris had basically negative days to produce this report. Okay? And then on top of that, trying to get staff from the other offices that are up to their you know what, with licensing to focus on something, and having spent something like 22 years of my career here in NRR, I can tell you right now, that when you're dealing with butt weld cracks, and everything else under the sun that's in front of you, the last thing you're thinking about is where do I want to be 5 or 10 years from now, what tools do I need?

So, first, just trying to get their attention to focus on this, I think was a miracle. And then to even expect that they're really going to put a lot of deep thought and say where do I want to be 10 years from now, when I'm sitting here trying to figure out if I've got to shut down plants for inspections and all this. And then to get a report up to the Commission by the end of February, which is what we were trying to do - the only thing we could do was to solicit internally from the offices. And you've got to remember that the reason we were trying to get something up there is, this is - right now we're in FY `09 budget formulation space, and the Commission, the Chairman wanted us to identify what we needed to get it into the `09 budget request. But he

needed a support document, as he said, I can't just go in and say I want to put $5 million and 8 FTE in a budget, and trust me, Research is going to go off and do something good with it. All right? He needed something more, and so that's why we wanted to get something on paper, at least in a short period.

The next step, once we got it to the Commission and said here's our first cut at it, is to say now we need to go out and solicit from others. We want to get the ACRS involved, we want to get the laboratories, the universities, we want to get DOE, we want to get the industry. What do they think?

And, again, remember, this is a living document. This is not something that once June or July comes and we send a report up, that's it. Okay?

DR. ARMIJO: I understand. So your target is to meet the budget requirement, you've got to be finished by July, to have something to --

MR. SHERON: Well, actually, we've actually put the numbers I just gave you before.

DR. ARMIJO: Okay.

MR. SHERON: That's been put in our FY `09 budget request. Okay? But that's based on the preliminary work that we did internally. Okay? But we need to keep adding on that, we need to keep

improving it.

DR. ARMIJO: Well, if you got external input of the sources you talked about that haven't been tapped yet, and came up with some better ideas, you'd have no problem to say well, look, that's a better use for that long-term R&D money, than what we've identified so far.

MR. SHERON: Yes.

DR. ARMIJO: And you would revise it.

MS. LUI: Yes.

MR. SHERON: We could change the priorities.

DR. ARMIJO: Yes.

MR. SHERON: Or, depending upon when we see the need, for example, we would just put that into the `010 budget cycle.

DR. ARMIJO: Okay.

DR. WALLIS: So the impression I'm getting is that there was not a lot of stuff waiting, bubbling up and just needed the Chairman to ask for it, for it to be revealed. It's not as if a hundred flowers waiting to bloom, and just needs someone to water them, or something. You had difficulty extracting ideas, apparently, from this agency for long-term research.

MR. SHERON: I'm going to turn to Chris, because she and her staff here interacted mostly.

MS. LUI: By and large, the other program offices were really focusing on more near-term and current regulatory issues. And there were a couple of ideas that's looking at more forward-looking. And I think -- and given that -- I believe that this effort has already resulted in a lot of good collaboration and got people started thinking along that line, because they know that we're serious about doing this, and we want to keep this as a living document. So given that this is an initial effort, I think we are kind of carving out a process, and learning as we go. And at the same time, really start to try to motivate the other program offices in collaborating with us to go towards where we really would like to go, is to really start thinking seriously about where - 5, 10, 15 years from now where this agency is going to be.

CHAIRMAN POWERS: Let me ask you, if I look at your objectives, it emphasizes new program areas for emerging technologies. If you approach me when I'm in an operational division, I am likely not to know what the new program areas or emerging technologies are. I am very likely to know how I would like to do my current activities better or

faster, but you didn't seem to ask them that question. And I'm wondering why not?

MS. LUI: What -- even if we didn't ask that question, some of the input that we got actually focused on that particular issue, what Research can do to help me, to help the program office do the existing issue better. And the other thing is, we have a formal user need request process, so that's a common vehicle that we have used in collaboration with other program offices.

CHAIRMAN POWERS: Have you ever formulated a user need?

MS. LUI: Pardon me?

CHAIRMAN POWERS: Have you ever formulated a user need?

MS. LUI: Yes. I used to be in program office, myself, before.

CHAIRMAN POWERS: Did you ever send one over that says go do some stuff for me, and make my life better? No, you have to be very specific when you formulate a user need, or you will die in the prioritization process. And that's the answer you would get from me, if I was in the program office, and doing things, and I said I'd really like to do this better and faster. If I knew how to do it better and

faster, that's what I would do.

MR. SHERON: We addressed that very issue. Okay? And maybe it's my fault, but I said that if it's something that -- in other words, we were trying to make the distinction between what do I need in the long-term, what do I need 5 or 10 years from now, as opposed to, if I had it now, that would be great, too. Okay? In other words, it's not necessarily something I need in the long-term, it's something that if I needed it now, that would even be better. Okay? And we didn't put that in the category of long-term research. Okay? Because there was a lot of stuff that was asked for, or was suggested, and we screened it out because we said that's something that if we had the resources, we'd do it today. Okay? Because we need it today, or we need it tomorrow. But we don't need - it's not like it's needed 5 or 10 years from now. You see what I'm making as a distinction here?

CHAIRMAN POWERS: I understand your --

MR. SHERON: And that doesn't mean we're not going to do it. It just means that --

CHAIRMAN POWERS: It does mean you're not going to do it.

MR. SHERON: No, it means it falls into a different bin.

CHAIRMAN POWERS: And it loses on the hierarchy plan.

MR. SHERON: No, not necessarily. It just means that we would do it within the current research plan, the current research budget. All right? And it wouldn't be a long-term, because it's something that, in fact, the user needs it now. And we would put it in that process, and prioritize it in that process.

MS. LUI: Actually, we did a tally that - Don, help me out if I don't remember the numbers right exactly, about 75 percent of the input we got actually got considered in FY `08 budget restacking process. So they did not go off from the cliff, they were actually captured, and then being considered, as Brian indicated, in this other bin.

DR. WALLIS: I'm trying to figure this out. I know if some thermal hydraulic research, which has been going on for about 10 years, hasn't yet been used, so, presumably, it's been addressing long-term needs, has it?

MR. SHERON: Can you be more specific, Graham?

DR. WALLIS: No, I don't want to be specific.

MR. SHERON: Okay.

DR. WALLIS: But it seems to me that some of it has been going on for a long time, and it hasn't produced useful results yet. And, presumably, that is long-term research. Is that right?

MS. LUI: Actually, I may understand what --

DR. WALLIS: That research takes a long time. Is that what you mean by long-term research?

MS. LUI: Yes.

DR. WALLIS: You may be doing it now, but it takes a long time to produce results.

MS. LUI: Correct. And that particular case that you have discussed here, I'll be specific. If you're talking about the TRACE thermal hydraulic code, we have released TRACE 5.0, and we're in the midst of getting all the documentation published.

DR. WALLIS: But the time you initiated TRACE, that would be a long-term need response, that would be why you did that? That wasn't what I was thinking of.

MR. SHERON: No, that's not -- if somebody said do I need the thermal hydraulic models in TRACE for some future reactor that's going to have some strange characteristic that I need these special models for. I'd say, yes, that's long-term research,

because it's needed down the road, it's not needed today. There's working I'm doing on thermal hydraulics, that if I had those models today, I'd use them today, but they just take time to develop.

DR. WALLIS: That's not a long-term.

MR. SHERON: That's not what we're defining as --

DR. WALLIS: The result isn't there for 5 years, or 10 years.

MR. SHERON: Yes. What we're trying to define as long-term is, what do we need down the road? For example, and LMR, Liquid Metal Reactor, we presume that at some time down the road, DOE is going to come in and what to get licensed a Liquid Metal Burner Reactor. Okay? What do we need, what tools do we need in place to meet that need, which may be 4, 5, 10 years from now, who knows? Okay? That's long-term research. Okay? It's getting the tools that we're going to need down the road in place at that time.

DR. WALLIS: The fact that you have so few of these long-term needs identified indicates to me that these things, maybe, are not going to happen.

MR. SHERON: There's a big uncertain -- the longer you go out in time, the bigger the uncertainty.

DR. CORRADINI: I'm late, I'm sorry. But the way you just defined it, I interpret it to mean that you're really choosing by technology class as the way you define long-term; that is, a gas reactor, a liquid metal reactor, or any of associated fuel fabrication, reprocessing facilities. Anything in light water might be automatically considered more near-term, and not fit into this. Is that it?

MR. SHERON: No. For example, we identify nanotechnology as something we wanted to take a look at. Okay? Is that a technology that is going to evolve to the point where the industry may say I want to use that in light water reactors, for some reason. I don't know. Okay?

DR. CORRADINI: Oh.

MR. SHERON: I could tell you right now, I mean, 6 or 7 years ago, we were sitting there -- my long-term research planning would have been decommissioning. Okay? You know, what do I have to do --

CHAIRMAN POWERS: And was.

MR. SHERON: And was. So, I mean, that's part of the problem, is you're trying to forecast out where you're going to be 5 or 10 years from now, what are you going to need? And you don't really know

what's going to happen in the whole socio-political environment that could change things.

DR. CORRADINI: So that's actually a good example of one, which is more cross-cutting; that is, if I develop something in a Materials aspect that actually could be applied, it could change the way you operate a current plant. Okay. But those are ones or twos, compared to when you use the example of the LMR or a gas reactor, that's a whole machine, and all the associated stuff that --

MR. SHERON: With the Inconel 690.

DR. CORRADINI: Okay?

MR. SHERON: They're off replacing everything, and they're saying Inconel 690 is the greatest thing since canned beer and sliced bread combined. Okay? Tough material. All right? They told us that, and this is even before I was in the industry, they told us that about Inconel 600. All right? And it's cracking away like you wouldn't believe. The question is, where are we going to be 20, 30 years from now with Inconel 690? Is there something we don't know about it? So long-term research might be to say, can we do accelerated aging tests, and look at Inconel 690. Does that help?

DR. CORRADINI: That's helps.

MR. SHERON: Okay.

DR. ARMIJO: Brian, is that in this plan? That I can understand, because there's a lot of things I have concerns about, water chemistry, is hydrogen really that good, is the water chemist, the new Zinc stuff, is that going to work? Can we really rely on it? Can we rely on the existing so-called improved materials? And is that in the plan as long-term research, or is that something that'll evolve, and be supported by the $73 million that's your current budget?

MR. SHERON: I'm not sure. Is that in there, Chris, or is this -- I know we're doing some work on it, but I just don't know if it's in this plan, or whether it's in the --

MS. LUI: I think Rob will be able to address that in the technical sense. But just for clarification purpose, I think we're getting mixed up with between long-term and long-running. There are research that will take a long time to complete, versus there is research work that we project that will be needed 5, or 10, or maybe 15 years down the line.

DR. CORRADINI: Right. But I think Brian -- I'll just pick on this one example, because this is

a very good example, just take the materials, whether it be modification of a material surface using some sort of advanced scientific technique, or a new alloy. To me, it could benefit the current class of plants, so it could be long-running, and I guess what Sam's asking is, is it long-term, or is it in the current research plan? That's what I --

DR. ARMIJO: Yes, right. And it's a matter of, are we satisfied with the things that we have right now, materials, water chemistry, is the industry going to be real happy, but we're still going to be looking ahead to see if it's really as good as people expect, so that we're not caught with our -- we're not surprised in the future. And, to me, that would be a hard thing to get funded, but it should be funded. And if that goes into a long-term plan, I think it's the right thing to --

DR. CORRADINI: So, I guess, what I --

CHAIRMAN POWERS: I'm going to intercede now. It's important for our schedule that Christiana get through her presentation. She's five viewgraphs into 16, so I'd like you to go ahead and at least get us through step one.

MS. LUI: Okay. All right. This afternoon, where we get into a technical topic

discussion, that's where we can really address your issues here. And just quickly, we also have a proactive material research plan, that we can address that in combination with --

CHAIRMAN POWERS: Which has disappeared off the face of the earth someplace. Don't answer that.

MR. TREGONING: It's not in the plan, but it's something that's being actively worked, at this point.

CHAIRMAN POWERS: A topic for another day.

MR. TREGONING: Okay.

CHAIRMAN POWERS: Let me just ask, did you make an attempt, maybe not in this stage, but eventually, to benchmark any of your long-term research planning philosophy, not specifics, but philosophy, against approaches used by other institutions for long-term research planning? And within the government, I might call attention to things like DARPA, Army Materials Research Program, and a previous area I would call attention to Bell Laboratories, I don't do that any more. But I might call attention to DuPont, other relatively static organizations that do depend on research or something. And, again, in another area, I might call attention to

Eastman Kodak, I won't call attention to it now, but do you try to do that? Have you considered things like Burton Klein's Second Law of Economics, where he addresses the question of how closely research should be tied to operational organizations in order to encourage innovation?

MS. LUI: Doing step one, we did not exclusively look at the other. We did have a sample, for example, international organizations, how they have characterized their research work. In terms of looking broadly to the other industries, we have not done so yet. It does not mean that we will not do that. And at the same time, regarding how quickly we have to turn the FY `09 thing around, that would be -- that particular consideration will probably be incorporated into future updates.

CHAIRMAN POWERS: I note that the European Union was engaged in their planning for their seventh shared research program, contemporaneous with your work; yet, they do not show up on your list of organizations you've contacted.

MS. LUI: I guess we need to move on to the next couple of slides, because step one was whatever we can get our hands on, that's where we collected our information. And in step two, that's

where we're going to outreach to the other organizations, and take a more comprehensive look at the other plans that --

CHAIRMAN POWERS: For instance, you did not have anyone attend their FISA conference, where they actually displayed their thinking on five-year forward research plan, which was all devoted to emerging technologies.

MR. SHERON: When was this, Dana?

CHAIRMAN POWERS: Last year. Just about exactly one year from today.

MR. SHERON: Okay. Well, I mean, actually, we weren't --

CHAIRMAN POWERS: You weren't in business at that time.

MR. SHERON: We weren't in this business at the time, you might say.

CHAIRMAN POWERS: Excusable then. You're excused. Please continue, and don't let me interrupt you any more.

MS. LUI: Yes. Okay. All right. Next slide. This slide, just quickly that we did complete our step one process, and the information was provided to the Commission on April 6th.

Going into a little bit more detail on

Lessons Learned during step one of the process, that we actually have received very good staff participation, and we will continue to encourage, and continue the staff participation. In particular, we have office instructions within the Office of Nuclear Regulatory Research, to find what would be the process for staff recommending research topic areas. And during step two of the process, we will be updating that office instruction so that it will be a formal process for the staff to follow.

And, as discussed before, most of the initial proposals that are coming from the staff, and also coming from the other program offices were not really for long-term, close now, not really long-term focused. They're really focused on current and near-term work, and a lot of them have been considered and incorporated into the FY `08 budget restacking.

Information organization is a challenge. In other words, how do we capture all these various recommendations and suggestions, and present them in a way that would be clear, and also get at the integration issue to actually let people know that we have looked at cross-technical disciplines to come up with the activity description? And during the first draft of this particular plan, we did try to tabulate

all the information based on about a dozen technical areas, and we found that when we start to really zero in on just new, different, and forward-looking, there are technical areas that did not necessarily have input at this point in time. It does not mean that we are not actively soliciting ideas in those areas, just that at this point in time, they don't really -- there have not been any forward-looking activity identified.

We do have a lot of research plans that are in existence in the very technical areas. The Project Material Research Plan, the Digital I&C Research Plan, I know that we're working on the Seismic Research Plan, and in the not too distant future, we will be coming in front of you to discuss the Advanced Reactor Infrastructure Plan. So there are various detailed - I mean, other research plans in existence, but not for every single technical area. And, also, the level of detail of these research plans are at different levels. And, also, we have discovered that a lot of these planning documents are internal documents, so there is going -- if we are going to integrate as a high-level document, then there will be some combination, housecleaning, and determination of the level of detail, so there is going to be a fair amount of work to really merge

everything together. And, again, generally, these research plans focus on the current and near-term, and forward-looking aspect is usually a secondary consideration.

Another thing we have learned is timing of this document is very, very crucial in terms of how it will work with the budget planning process. And we have a few more slides on budget planning process, a little bit more detail, so I will explain this bullet when we get to that particular slide. And as I have indicated before, that even though we did this on a very fast term, and we did get good collaboration from the other offices, and we believe that we're laying a foundation for agency-wide cooperation, and we will increase the transparency and traceability of the planning process. And, clearly, if we were to do this more systematically, and incorporate that into the agency planning process, there will be resources associated with it.

Now, step two of the process, our commitment is that we will provide the proposed final FY `09 long-term research plan to the Commission in July, and we will continue to interact with the other program offices to get their feedback. And we are seeking, particularly input from ACRS, and later on

this month we are going in front of the ACNW, and we will formally solicit input from external stakeholders, such as DOE, industry, universities, labs, and international organizations.

CHAIRMAN POWERS: It seems to me, not too terribly long ago, that the laboratories were approached asking this question of what is the longer-term research that needs to be done, and they produced a brief little report that basically said the most important thing NRC could fund is whatever they're funding with this laboratory at this time. Is that a fair characterization?

MR. SHERON: When was this done?

CHAIRMAN POWERS: Maybe two years ago.

MR. SHERON: I was not in Research at the time, so I --

CHAIRMAN POWERS: You're not responsible, I understand.

MR. SHERON: I understand, but I'm not familiar with the report, so I can't --

CHAIRMAN POWERS: I'll have to dig it out, because I did have it, and it was easily the most useless report I have read to-date. And it was produced by the laboratories, and I think I have fairly characterized it, that it came back and each

laboratory said the most important thing for the NRC to fund is whatever they're funding now at this laboratory.

MR. SHERON: And more.

CHAIRMAN POWERS: And was about as forward-looking as a coffee break. I mean, it just was not useful. And whatever was done to solicit their input to that report, obviously, was not a useful activity. And to the extent you can do something different, do something different, because that response --

MR. SHERON: I wanted -- I mean, to the extent that laboratories are going to provide things that are self-serving, I can't stop that. Okay? Obviously, they're looking out for their financial future, so there'll always be a bias there. Okay? That's why we're going - and I would not put it passed universities to do the same thing. Okay?

DR. CORRADINI: I'm shocked, and hurt.

CHAIRMAN POWERS: I guess what surprised me more than anything, Brian, was the consistency with which the responses came back. I mean, I have not been unfair in my characterization of it.

MR. SHERON: I think what we want to do is to -- I mean, to the extent that they provide useful

suggestions, we will take them. To the extent that we recognize them as being self-serving, we won't take them. I think the industry is going to be a valuable source, because it's really a matter of where do they think they're going, because that's where -- I mean, it's -- our job is not to go off and solve technology problems for the industry, and to create new and better ways to generate electric power. Our job is to ensure safety and to make sure the agency is prepared to deal with the innovations or whatever that the industry puts in front of us down the road. But, like I said, our job is not to go out and solve - to do pure research. In other words, to advance the state-of-the-art.

DR. WALLIS: But I'm really puzzled here. I mean, I looked through the slides. There's nothing here about PBMR, for instance. If I had to license a PBMR today, I think there would be about 10 technical questions that would occur to me, I wouldn't know how to answer them.

MR. SHERON: We have a complete advanced reactor research plan, which is not --

DR. WALLIS: It's not part of this, at all.

MR. SHERON: No, it's not. It's not in --

DR. WALLIS: Okay. That's something else, all together.

MR. SHERON: We can certainly come down and brief you on the advanced reactor --

DR. WALLIS: Well, this is research that doesn't fit into any other category, whatever. Right?

CHAIRMAN POWERS: And that briefing, in fact, is on our agenda, someplace.

DR. CORRADINI: But just for clarification, Brian; so the reason that an advanced reactor, such as a gas reactor, doesn't fit into this, is that is already known to be in the sights of some of the industry, and closer in time, and also funded, that it wouldn't fit into this category? Those three attributes take it out of this category. Is that a -- I'm trying to understand what attributes put things in the bin, and what attributes take it out of the bin. And so what I heard was (a) the industry may be interested; and (b), you already have it somewhere in the budget in an office to worry about it; and (c), it might be of a time scale that is close enough that it's not 15 years out, it's closer. Am I missing -- that's what I'm still struggling for, is the attributes that put it here, versus somewhere else.

MS. LUI: That's a pretty fair characterization. And the main reason, because it has a stand-alone document that talks about the work that we are planning in that particular area. And in our budget process, there is already resources allocated for non-light water reactor work.

DR. CORRADINI: So those three attributes I said actually might be the operative ones to decide where it fits?

MR. SHERON: The Commission already gave us almost five point something million dollars to work on gas-cooled reactors. We have the Energy Policy Act, which --

DR. CORRADINI: Right. Which, essentially, kind of tells you guys to go work together.

MR. SHERON: Go work with DOE to come up with a licensing strategy, and so forth. So, yes, that's all being done as part of a separate plan that was already developed.

DR. CORRADINI: Okay. That helps. Thank you.

MS. LUI: You're welcome. And understanding where you're coming from, Dana, we still believe that the objective of step number two is to really help us to identify any other potential topical

areas that has not surfaced during step one. And the other objective is to identify potential opportunities for collaborative effort, so we can leverage our resources.

And, of course, right now, as the document stands as we have gone to the next level to really identify key milestones and make the deliverable as succinct as possible, so we will do that as part of step two of the process. And we will develop a communication plan so that it will allow us to really target the -- to get material from these plans for a targeted audience.

And, separately, we are looking at how we can do a more systematic update of the long-term research plan for the future, how that will work with the current budget planning cycle. And as Brian has indicated before, we will also evaluate the need for separate prioritization, that includes pursuing alternative source of funding.

DR. WALLIS: I'm just thinking, all this emphasis on process, is a wonderful way to kill all creativity.

MS. LUI: I would --

CHAIRMAN POWERS: He's just venting. Go ahead.

(Laughter.)

MS. LUI: Well, actually I believe that slide 9 emphasizes why a process would be necessary, because we will continue to encourage creativity, but want to turn creativity into something practicality so we can implement. And given that we have a budget process that we have to follow, so when that creativity will have to come to fruition, it's really important so people can understand where we are in the cycle, and understanding that if their creativity, their idea did not make it into this particular cycle, when will it be the next time it gets considered? That's where -- and I agree with you, that we don't want to put process on top of process, and at the same time we need to have a common understanding how we're doing this --

DR. WALLIS: It just seems to me, if anything is worth doing, there ought to be somebody in the agency who's jumping up and down saying we've got to do this, and I haven't done anything like that. And all this emphasis on process just tells me there isn't anything there. But, anyway, go ahead.

DR. ABDEL-KHALIK: If somebody had started this process 15 years ago, this whole thing would be just a small piece of whatever plan they would have

come up with back then, because there are a lot of other pieces that you say, for which individual plans have already been developed, and are being pursued. And, therefore, it seems to me that you just sort of looking at small part, without providing people with a big roadmap that includes everything at a high level.

MR. SHERON: You're absolutely right, and the problem we had is that the amount of time we had to generate this report, you would either have a document that was going to be this thick. All right? Or you would have a document that would be of such a high level that this piece would be a page or two of it.

DR. ARMIJO: That's all I'm looking for, one chart that says for the 73 million bucks that we got right now, our annual budget for research, we're supporting the light water reactors, and this piece of those light water reactors is the module for advanced reactors, whether it's GNEP, or gas reactor stuff. And then this long-term plan is new, brand new, and this is all we're going to talk to you about today. I'd be happy. I'd say okay, these other things --

CHAIRMAN POWERS: You're going to be unhappy because they don't have that. Now, let's go

on.

DR. ABDEL-KHALIK: But there is no harm in sort of stating that --

MR. SHERON: We can come down and talk to you about our --

CHAIRMAN POWERS: And you've stated it. We've got to stay on schedule.

DR. ABDEL-KHALIK: In a sense that if you have that high-level document, and somebody is interested in a part of it, for which you already have a detailed plan, you can just refer to that detailed plan. You don't have to produce one full --

MR. SHERON: It's on my FY `09 budget request, unfortunately, but it's still pre-decisional, so I can't even --

CHAIRMAN POWERS: Please go ahead.

MS. LUI: Okay. So coming back to slide 9, usually around the time of October, November, and December, that's when the agency will come out with budget assumptions for -- right now, for example, with FY `07, the budget assumption is for FY `09, so we are always two years ahead of time. And at the same time, the FY `08 budget is being reviewed by Office of Management and Budget, so we're getting feedback on the FY `08 budget, so at any given time that we are

actually working on two years budget, that's two years out, and then the very next year. So what we are looking at is to make the future update of the plan in such a way that you form the current FY, plus two. And, also, looking at do we need to restack the FY plus one budget. That's where the process and timing becomes important regarding when we consolidate the idea, when we reach out to the other program offices, and when we adjust the resources that has been approved, and looking at what are the other items that we would not be able to do, because we do not have the necessary resources, so we can continue to roll that into the next planning cycle.

DR. ABDEL-KHALIK: So this is what you plan to do for FY `10, FY `11, `12, et cetera.

MS. LUI: Correct. Slide number 10 - we come in front of the committee, and the committee continues to provide your recommendation based on your review of the individual research activities, and your review of the program offices' activities, and also, at Commission's request. And we are also aware that every two years, you do publish your report, NUREG 1635, to make recommendation and comment on the research program, in particular. So while we believe that in the future, how we can really integrate your

recommendation into our planning cycle, we will continue to look at the recommendations that come in from the committee on the individual research activity review.

And we also need to prioritize among other things your recommendation by collaborating with the other program offices, and other stakeholders. And as I have described in the previous slide, we would look at funding based on what particular cycle we're in, to see where the recommendation can be incorporated into the current or future budget planning.

And, of course, that we understand that you will be providing your recommendation to the Commission in March 2008, so that would be very timely for us to incorporate your recommendation into the FY `10 update of this particular research plan.

Slide 11 talks about the considerations of identifying long-term research activities. I think we were kind of touched upon this slide in some of the previous exchange that we had. Clearly, it needs to be consistent with the agency's mission, the strategic plan, in particular. And we would look at whether there's research being conducted by industry and other organizations, and look at the roles and responsibilities, and make sure that NRC is not doing

work that is supposed to be carried out by the industry. And at the same time, we will look for collaborative opportunities on items of common interest. And we need to look at the potential benefit of research, such as, does this help us to address any forward-looking issue, and also, does this help us to maintain the knowledge and capability in the area that we believe it's going to be needed in the future.

And look at the current state-of-the-art in a particular technical area and see what is the potential for that particular technology advancement being applied in anything related to nuclear industry, and also, upgrade our own technical analysis capability. And, also, looking at what is the complexity of the technology, and decide whether this is something that we need to really start now, or you can wait a little bit longer, and be considered in future budget. And, also, look at the potential need, and the timing of this particular work, or topical area, that may enter into our regulatory horizon. So these are some of the considerations that we have looked at in identifying the long-term research activity, during step one of the process.

Just to kind of summarize some of the

observations that we have already talked about, that our current budget process favors the priority assignment, favors assigning high priority to resolving current and near-term needs. And while we are looking at prioritization of the long-term research activities, as such, doing step one, we did consolidate all the ideas that we have collected through the various input channel, and we presented to management, and as Brian has indicated, that we asked ourselves, is this something that we need now, or is this something that would reflect something down the road? And if it's something that we should address now, then that gets put into a different bin.

Deprioritization or whether these activities will actually make it into the agency budget is currently ongoing as part of the FY `09 budget deliberation, so because we have not received any final decision yet, we do not exactly know where these will stack. And I believe at this point, the staff proposed budget will go to the Commission sometime in the early summer, and the Commission will evaluate where the agency needs will be by the end of the summer.

DR. ABDEL-KHALIK: This will always be a problem, as long as the prioritization is done at the

specific program level. But if the prioritization is done at a higher level, where all long-term research is sort of lumped together, rather than parsed out as specific research programs to be prioritized against everybody else, maybe you would fare better in the prioritization process.

MS. LUI: In fact, this particular go-around, we did not assign priority to long-term activities. As Brian indicated, that we identified these activities as additional resources that we are looking for to carry out these particular set of candidate activities. So at a staff level, we did not prioritize where an issue fit. And there is a common prioritization process that the agency follows in looking at all the various proposals that come in, so while we have indicated to the Commission that we're going to see how this whole - this new idea will fare out in the current budget cycle, and make recommendation at the end of the FY `09 budget process regarding how we should march forward for the future, for the FY `10 and beyond planning cycle, whether we need to examine how we want to do a common prioritization, or are we going to come in and recommend that to pursue alternative funding sources for these type of activities.

DR. CORRADINI: Can I say that back to you so I understood it?

MS. LUI: Yes.

DR. CORRADINI: So your point is, is that there'll be a small slice of all that you're essentially determining, and that's going to bubble up as candidate research in `09.

MS. LUI: Correct.

DR. CORRADINI: And to determine which bubbles up, and where it fits in the pecking order of getting money will be determined later.

MS. LUI: It's being --

DR. CORRADINI: This summer.

MS. LUI: It's being decided right now. Yes.

DR. CORRADINI: Right. But then it has to go - if I understood the process, it goes to the Commission, and the staff there then says okay, it starts moving things about, given the resources of what is expected in `09 for the request.

MS. LUI: Correct.

DR. CORRADINI: Okay. Fine.

DR. WALLIS: How will it bubble up? If you said we've got $5 million, we invite proposals or something, then you have a way of stimulating the

bubble. I think nothing will bubble up at all, if we're not careful. The whole thing will just die. Have some way of stimulating the bubble-up process, something that's rather difficult to stimulate.

MS. LUI: You mean, get visibility on Commission level so there is --

DR. WALLIS: Propose good ideas for this sort of thing. That's the biggest problem I see with the whole thing.

MR. SHERON: I think when we go and we interact with our external stakeholders, and they see money, they'll come up with a lot of good things.

DR. WALLIS: When they see money, yes. That's the way to get it to bubble up.

DR. SHACK: Well, to a certain extent here they've done it. I mean, they found some ideas, they found some money for it. I think what Brian wants to avoid is the other thing, I've got $10 million, give me enough ideas so I can spend it all.

MR. SHERON: Right.

DR. SHACK: There's two processes here. How many good ideas can I find, and then I'll find the money to fund them, or I've got a given amount of money. I guarantee you that the labs and other organizations will find enough ways to spend it.

MR. SHERON: Presumably, if the requested budget goes through and we get the money that we asked for in `09, there's not a problem.

DR. SHACK: No. And it seems to me that you actually then do have an incentive - if people can see that if they generate ideas, and there is a, if not a set goal, if you can come up with a good enough idea, we'll go out and get the money for it - to me, that's the incentive that you need, rather than saying okay, we've got 10 million bucks, give me some ideas.

MR. SHERON: Exactly. We did not want to go into this with give me 10 million, or give me 20 million, and I'll go figure out how to spend it, and the like. We wanted to work it the other way around, as to say, what work makes sense --

DR. SHACK: What's important is to deliver on the 5 million. I think, to show that, in fact, the process will work.

The other question I had, just aside from this money, what other fraction of the research isn't supported by user need at this point? Is it zero, 1 percent, 10 percent?

MR. SHERON: Well, I don't know what the percentage is. I would probably guess it's maybe somewhere in the 10 to 20 percent, but when you say

not supported by user need, remember, there's a lot of work that we do that the regulators want, the agency wants, but I don't have a particular - like the ASP program, for example, the generic issue program, I don't have a user need letter.

DR. SHACK: Okay. I meant research, rather than some of your other tasks. ASP, I think, is a special - I mean, I'm thinking of things that really float as research.

MR. SHERON: I don't know whether we've broken that out. I've kind of emphasized to the staff that the work that we do, whether it's got a user need or not, should have some endorsement from the potential customer offices, that this is -- in other words, the last thing I can do is have somebody like NRR or NRO looking at work we're doing and going, we'll never use that. That's crazy. Why are you doing that? Okay? Because I was in that position when I was in NRR, and it was back in the past. There was times when I looked at research, and I would say there's no way in the world NRR will ever use that. We don't do that kind of work here. Okay? And there was no interaction. In other words, because research had not come over and said here's some work we want to do. What do you guys think? All right? So I told my

staff, I have no problem, if we think there's valuable work to do, but go over and talk to your potential customer, and make sure they are in at least fundamental, basic agreement that this is worthwhile things to pursue. They don't have to write a user need, articulating exactly how they'll use it, and the like. But, at least, yes, we think this is valuable. We think that if it pans out, it's something that we will likely be able to use. That's all I've asked my staff to do, so I'm hoping that I could tell you that all of the work in research has some endorsement from a user office. Okay? And it's not just, we're off working on our own without the other offices even knowing what it is.

MS. LUI: Okay. Just one point to add, it depends on whether we have additional resources. If we have additional resources, a lot of times we actually fund university grants, and cooperative agreements, and those work generally support the agency's mission, but you can really treat those as something that we don't really have a standing user need, and is more research in nature. And the percentage will vary from year-to-year. It would depend on how much resources is available for us to provide those type of support to other organizations.

Now talking about funding possible options. This goes into a little bit more detail about the budget cycle we discussed in a couple of slides before. We are using the existing budget process clearly for FY `09 in terms of prioritization of the activities that we're proposing here. So we recognize before we even went into the FY `09 budget cycle that the common prioritization process generally favors something that's near-term and current. So we have already indicated that there will probably be a need to re-examine how we can continue to keep the long-term research alive. It may be that we need to modify the common prioritization to make the long-term research part of the common prioritization, or just take the long-term research out completely, and pursuing alternative funding cycle, I mean, alternative funding resource, or we can go with a designated level of funds that would be dedicated to long-term research. So these are some of the ideas floating around, and if you -- I know that you have a lot of ideas in this area that has come through, through the discussion that we had so far. If you continue to have other insights, we will be certainly happy to hear them.

CHAIRMAN POWERS: Ordinarily, ACRS would

not comment on this, because it's strictly a management function. I mean, our comments, we'd come back and say you need a long-term research program. You go take care of it. We would not comment on the process for funding. I will be polling the members at the conclusion of this meeting specifically on this question of their comment on it. But I'd say, ordinarily, we would not respond to these options, except, perhaps to say, indeed, they've covered the options, or not. I mean, you're talking about a strictly management function, and we don't claim to have expertise in that.

MR. SHERON: We've brought this to the attention of the Commission.

CHAIRMAN POWERS: They do have to comment on it.

MR. SHERON: Yes. And we've explained to them that if we follow the common prioritization process in times of budget shortfalls, where we have to decide what doesn't get done, if we follow the normal process, you need to recognize that this kind of work might fall off. Okay? And we told them, this is really a Commission decision, how they want to do this.

MR. SIU: Excuse me. But I think on the

other hand, Dana, your point about DARPA, for example, other agencies, and how they address this particular issue, I'd imagine that would be of interest to us to hear, if the committee members have experience with that.

CHAIRMAN POWERS: That -- I mean, DARPA has an advantage in that the decision has already been made.

MR. SIU: Yes.

CHAIRMAN POWERS: Thou shalt have a defense agency looking at long-term research not tied to specific activities, where they can take advantage of emerging technologies, or potentially emerging technologies. The decision has already been made for them. More interesting, I think, might be the Army Materials Research Program, where they have exactly your problem, where decision has not been made, and even once it's made, it can always be revisited. They are very good, by the way, because they have a very high-level mission, and they have a very top-down approach to that, with a strong long-term focus.

MR. SIU: Thank you.

MS. LUI: Okay. The next three slides pretty much gives you a preview of what's coming up in the afternoon.

CHAIRMAN POWERS: Yes, and I think you -- maybe the best thing to do is to use the next few slides as the introduction to this afternoon's discussion.

MS. LUI: Yes.

CHAIRMAN POWERS: And then you can spiel off. I assume your colleagues will expand magnificently on each one of the topics.

MS. LUI: Correct. So I think we should just go to slides 15 and 16 directly. Okay?

Right now, the proposed activities that we have identified at the end of step one, really falls into three major categories. One category is specific agency program projects that we are anticipating that's going to come up in the next 5 to 10 years. And that includes the Global Nuclear Energy Partnership program that we're following closely, of what DOE is doing, and anticipating what would be the regulatory roles for NRC.

The other item that we have already mentioned earlier is the license renewal beyond 60. And the next category would be potential test facilities that we need to support whatever identified needs that we have so far for the next 5 to 10 years. In particular, there are two facilities that we have

come forward. One is the integrated test facility for Digital I&C, and the human factor. The other one is the potential need for large integral or separate test facility for advanced reactors, because these test facilities is usually very costly, so we really want to make sure that if we are pursuing this area, we identify any collaborative opportunities that might exist.

And the last category is cross-cutting research. That includes a lot of the research that addressed technical issues common to multiple regulatory programs and initiatives. And they generally focus on potential new technology to be applied in the nuclear industry, such as nanotechnology, and also potential for improving our analytical proofs because of the technology advancement, such as advanced computational capabilities.

And slide 15 and 16 really goes into a lot more detail on this cross-cutting category, and we are -- I know that this is not a fully integrated research plan at this point in time, even given the amount of time we had to work on this, but cross-cutting research is our first attempt at looking at integrating among the technical disciplines. We can

certainly do better in the future, and also, organize this in a different way.

And we are prepared to discuss all these proposal activities with you this afternoon. And our plan is to go through the plan presentation in sequence, if you don't have any other preference that you want to hear something earlier, rather than later, or you are not interested in anything at all, at this point in time.

CHAIRMAN POWERS: I think we will be quite interested in just about everything you have to say. I propose at this point that we recess for lunch. That we come back, and maybe you can begin again with your summary, and that will start the individual discussions.

MS. LUI: Okay.

CHAIRMAN POWERS: Any members have closing comments that they want to make before the recess? Then we will recess until 1:00.

MS. LUI: Thank you.

(Whereupon, the proceedings went off the record at 12:01 p.m., and went back on the record at 1:00 p.m.)

CHAIRMAN POWERS: Just as a reminder, we have had an overview of the general thrust here.

Christiana has presented us a slide that says they have basically four categories of activities that they propose.

One deals with the GNEP, the Global Nuclear Energy Partnership. The other one deals with the possibility of renewal of license reactors beyond 60 years. The third one deals with test facilities. The final one they call cross-cutting and emergent technologies. That seems to be the one that they have done their first stab at breaking it down into finer categorizations.

Okay. So I'll turn it back to you.

II. CANDIDATE LONG-TERM RESEARCH ACTIVITIES

MS. LIU: Okay. This afternoon we will be discussing all these candidate activities in a lot more detail and take us away from the process description that we went into detail this morning and just want to add to that in terms of the cross-cutting and emergent technologies, that's where we identified the various cross-cutting areas.

The other, the other three categories, clearly for the GNEP and the reactor license renewal beyond 60 years, they are particular regulatory programs. So we did not break them down further.

On the other hand, when we go into a

discussion of these regulatory programs, we will highlight what are the issues that we are talking about we think that for those particular programs.

The way we have approached in drafting these documents is Nathan, Rob, and Don each all have their comments in technical areas where they served as a principal point of contact working with the staff, working the program offices. So what we will do is for the rest of this afternoon, we will go into the technical description here.

First off, I'm going to slide number 18, where we are going to start with Global Nuclear Energy Partnership program. Don?

MR. HELTON: My name is Don Helton. I am a member of the Office of Nuclear Regulatory Research.

The first item here is Global Nuclear Energy Partnership, which is a Department of Energy program dealing with a number of objectives. If I can name just one or two that we deal with, reprocessing of spent fuel, including the transmutation of long-lived transuranics into shorter-lived isotopes.

We are identifying it as an area here, where if the NRC is going to license these types of facilities, then activities would need to be undertaken to develop the regulatory infrastructure

needs and the technical bases for doing that.

NRC is already interacting with DOE on this topic. DOE is in the process of deciding which technologies it will pursue and to what scale it will pursue things. That decision is coming in June of 2008.

The NRC is internally evaluating the licensing options that are available in terms of how we would license the facilities, including any rulemakings that would be necessary to support that licensing. The current technologies that DOE seems to be leaning towards are chemical separation for the reprocessing aspect and a liquid metal-cooled advanced burner reactor for the transmutation aspect.

Obvious uses of this are for us to be able to license both the consolidated fuel treatment center, which is a reprocessing aspect, along with the advanced burner reactor. To do that, we would obviously need to develop the risk strategies and the acceptance criteria that we would need in order to license both facilities.

As I indicated before, we are awaiting the June 2008 decision from DOE in terms of the specifics of the technologies that they will pursue. We are preliminarily identifying some of the needs that we

think we would have and some of the work that we think we would need to do based on the direction they seem to be heading. But that can't be really ironed out too well until they have come up with the technologies that their --

MEMBER WALLIS: Other programs for advanced reactors are already in a different part of the program, but this piece is somehow in this part?

MR. HELTON: This is a programmatic area that would overlap to a good degree with the advanced reactor research that the office and that the agency is already doing. The advanced reactor research plan has recently started to incorporate liquid metal reactors along with the high temperature gas area that it had always covered. So there is definite overlap there.

CHAIRMAN POWERS: When I bring up GNEP licensing, safety and licensing, issues with the GNEP people, the usual response is, "Well, it should be no problem. The NRC did everything but issue a license for the FFTF reactor. They did everything, nearly everything, to get a license for Clinch River reactor. And they did a substantial amount of work in connection with PRISM. So, gee, we can just follow those prescriptions. We don't need to do anything of

a research nature in connection with the regulatory or safety issues of GNEP."

MR. HELTON: Right now both the Office of Nuclear Material Safety and Safeguards along with Nuclear Reactor Regulation are investigating the different avenues that are there in terms of licensing. They are looking at using existing licensing options, modifying the existing licensing options, and/or developing a new regulation specific to GNEP. All of that at this point is pre-decisional and is slated to go to the Commission in the near future.

CHAIRMAN POWERS: Well, I am sure that they are doing that sort of thing. What I am asking you here is do you foresee some research that is needed that apparently is not foreseen within the GNEP project itself. And I guess I am asking you, what is it that you see? And why do you see that?

MR. HELTON: Okay. First off, I think I am consistent in saying this, that there are research needs that folks elsewhere in this agency foresee. And they basically deal with -- you mentioned the previous LMR experience that we have. Certainly that will be used, but then certainly there are also going to be aspects of this design that will be evolutions

from the GE PRISM design or from whatever base design they choose. And the expectation is that that might require some accompanying research.

In addition, there is also the reprocessing aspect of GNEP, which is going to likely take a fair amount of research to build up the technical bases for licensing that aspect.

CHAIRMAN POWERS: As far as I know, the evolution of part of the designs -- and I'm far from an expert on this.

MR. HELTON: We're on safe ground with each other here, then.

CHAIRMAN POWERS: I really don't do very much in connection with GNEP. As far as I know, they have gone through this pool-type reactor and that has eliminated all the problems that we had in certainly the neutronics and criticality aspects of the loop-type reactors. So, I mean, it seems like it's an easier reactor, in fact, to do than certainly FFTF or Clinch River was because you had all the prompt criticality events and it's supposed to not be done, not be there anymore.

Now, whether they're really gone or not, time will tell, but certainly there are huge advantages in going to a pool-type reactor over a

loop-type reactor just for heat capacity's sake.

MR. HELTON: I guess the only thing I can offer is that at this point we are not at the stage where we would be able to provide a list of here are the specific systems changes or approach changes that would prompt new research. That's what we're investigating now in trying to --

CHAIRMAN POWERS: They aren't either.

MEMBER ARMIJO: Are they going to have an oxide core, a metallic fuel?

CHAIRMAN POWERS: One of those.

MEMBER CORRADINI: Either, one of them. Either.

MEMBER ARMIJO: So it's open?

MR. HELTON: Right, yes.

MEMBER ARMIJO: So this is really a placeholder?

MR. HELTON: Yes. It is something that has been identified for a while now by DOE that they are going to do this and that they are going to select the technologies in June of 2008.

The agency has basically recognized that it's coming and has been dealing with some of the regulatory infrastructure issues, but the Commission actually in an SRM was quick to say, you know, develop

the technical bases consistent with the uncertainty in what they are going to do.

So we think that by fiscal year 2009 they will have a good enough idea of what they are going to do to address some of the specifics. But right now we are not there yet.

MR. SIU: If I may comment, I mean, some of the points raised in the report were associated with the notion that you have this chemical process facility on the same site as the reactor.

So from a regulatory standpoint, of course, there's a question of how you're going to treat that. If we're going to change the way we're going to approach the regulation of one or the other, from a risk assessment standpoint, are there interactions? Are there things that we haven't yet addressed in our current studies?

So the questions were at least being raised at this point. Whether we actually do something --

CHAIRMAN POWERS: On the process facility, I said, "Well, you know, currently you're licensing the MOx facility at Savannah River."

MR. SIU: Yes.

CHAIRMAN POWERS: As the identical

technology, if they go an aqueous route, you don't have anything for the power chemical route, but their intent, in fact, is to start with the aqueous route, in which case it is identical to the MOx facility.

MEMBER CORRADINI: I didn't mean to interrupt you.

MR. SIU: Just again not being familiar with the location at Savannah, whether there is the same co-location kind of question that we might come up with this.

MEMBER ABDEL-KHALIK: Now these specific F.Y. '09 activities, would these be done in-house or would they be competitively funded through an RFP process? And if so, does that give you any time to actually do this, do anything meaningful in F.Y. '09?

MS. LIU: The F.Y. '09 process right now in the budget, we have both budget for FTE and contractor support. And in terms of what would be the contracting vehicle, it would depend what particular activities that we would zero in pending the DOE direction that they are going to come out in June 2008.

So what usually happens is in F.Y. '09, when we get the resources, we like to have whatever contractor support already in place to place the work.

And that may lay out not just the F.Y. '09 work and also future year work and in time to support the regulatory positions that we need to have in order to carry out our regulatory function.

So in a way, we are aware of what you are asking here. And we will put the tools in place to get the regulatory product we need pending the amount of resources that we have allocated to do the work.

MEMBER CORRADINI: So can I ask a follow-on question? Because one of you said that there will be a decision made in 2008. So there are three possibilities -- well, at least three but three easy ones: a) full speed ahead, b) can it, or c) none of the above but develop a test reactor and a test fuel program for that reactor.

Would this fade away in two of those three; that is, essentially a test reactor and a test fuel program, and essentially can the whole idea or would you be involved with DOE in essentially licensing the test reactor and those associated fuels?

MS. LIU: That's going to depend on where DOE is going to be coming out based on the discussion that we had with DOE, DOE indicated that, even if they don't come to NRC for license the facilities that they build, that they would like those to be

NRC-licensable.

MEMBER ARMIJO: Does DOE really have that option to just internally license everything that --

MEMBER CORRADINI: Yes, yes. Sure, they have.

CHAIRMAN POWERS: And what they did on the case of FFTF is they came to the NRC and said, "Run us through the process, but don't give us a license." Okay? And that's exactly what was done. We went through the full gamut, everything that would be done for a reactor, but they just didn't get a license at the end.

Quite frankly, if I had a facility and had the choice of going through NRC's process or DOE's internal process --

MEMBER CORRADINI: I choose NRC's.

CHAIRMAN POWERS: NRC's every time.

MEMBER CORRADINI: You bet you.

CHAIRMAN POWERS: At least it's understandable.

MEMBER CORRADINI: So, then, I mean, just to invent paths, two of the three still would require you to start down this path of developing a framework and all the associated issues is what I thought I heard you saying.

MS. LIU: Yes, correct. And one additional detail I wanted to point out is we have listed GNEP as one of the forward-looking research. At the same time, we did not request any NRC budget to do it.

What we have indicated to the Commission is that if, indeed, we need to pursue research in GNEP in a later area, we intend to establish a memorandum of understanding and get cost reimbursement from DOE at this point in time.

MEMBER CORRADINI: One more thing just for clarification. In deference to the GNEP, which is identified in the Energy Policy Act of 2005, where it says, "Thou shalt work together," in this one, there is no legislation nor authorization for collaboration. So this would be DOE's decision if they wanted to. Am I understanding this correctly?

MS. LIU: Yes. Right now there is a GNEP option paper that has been worked through going through the Commission. And Office of Nuclear Materials Safety and Safeguards has the lead on that particular paper. And they are laying out the various regulatory options and also where the funding could come from.

MEMBER CORRADINI: What office is taking

the lead on this?

MS. LIU: NMSS because they are the designated agency lead for GNEP issues.

MEMBER CORRADINI: Including the reactor?

MS. LIU: That's one of the options being worked out right now.

MEMBER CORRADINI: Okay.

MS. LIU: But for the time being --

MEMBER CORRADINI: For the time being they're the ones?

MS. LIU: Right, correct.

MEMBER CORRADINI: Thank you.

CHAIRMAN POWERS: Any other questions?

(No response.)

CHAIRMAN POWERS: Proceed.

MR. TREGONING: Okay. This next area, this next programmatic area, is reactor license renewal beyond 60 years. This is something, this is a topic that, interestingly enough, staff has talked about informally for at least some time, but in December of this year, DOE actually came to us and raised this as a possible area of collaboration. So we actually have engaged already with DOE on this, even though we haven't had any formal engagement with any specific licensees that might be coming and

looking for a license extension.

So the objective of this work that's identified in the long-term research plan is to evaluate and update as necessary the technical basis for supporting possible requests for license renewals beyond 60 years. And I mentioned this was something that at least recently we have had discussions with DOE about.

The technical background, we know that many of the plants to support not only continued operations but the first round of license renewals had made some fairly significant large-scale modifications of their safety-related SSCs, or systems, structures, and components.

So there are at least some incentives for the industry for those plants in particular to pursue license renewal. There's no regulatory impediment that exists. There are really two governing regulations. There is 10 CFR 51, which governs the environmental issues, and then 10 CFR 54, which handles the safety aspects of license renewal.

Like I mentioned, we have received at the point of this document some informal DOE inquiry. And we have actually met with DOE on this topic since this long-term research plan was developed. But we haven't

received any formal letter of intent from any licensee going on record that they are going to pursue this.

The earliest -- and this is an assumption. The earliest that we are expecting a renewal application would be between 2014 to 2019. The earliest that they can apply for a license renewal extension in the regulations is 20 years before their existing or current license runs out.

Now, if you look at plant licensing, the earliest a couple could come in on this would be 2009. We have a couple whose license extensions actually run out in 2029.

But, again, given where we are in license renewal in the current fleet, we are in the midst of the first round of license renewals, we certainly don't anticipate the next wave as soon as 2009. But 2014 to 2019, especially for those plants in the past, some plants have indicated that they at least would like a 10-year window to work through the NRC process as well as cover all the other state and federal impediments to license renewal that they have to go through.

The current technical basis that we base all of our license renewal or the GALL, the generic aging lessons learned report, and the GEIS report,

which are the generic environmental impact statements. The statements themselves, there's a separate summary attachment or appendix for each plant that comes into the GEIS document while the GALL again is a broader document that describes how aging managing programs should be managed by each licensee.

So the next slide on uses of research would be as much as we expect, we're going to be utilizing the process that we have in place now. There are no plans to change that process. It seems to be working pretty well for the current round of license renewals.

So what we are really going to be looking at is supporting modifications as necessary or may be needed to the GALL and GEIS documents so that we can extend the technical bases beyond 60 years. And if there are any corollary updates needed to SRPs and reg guides so that we make compensatory modifications with the GALL and GEIS documents, we will be looking at that as well.

In F.Y. '09, it's really what we're planning in '09 is essentially a scoping study. We're coupling it in some areas in some sense with some other research that we're going to talk about later in this plan. And that's identifying essentially

advanced sensors.

There are some areas with respect to buried tanks and piping where we think sensors to help us with environmental monitoring may be particularly appropriate and useful. And so we will be looking at areas where we can combine some of these advanced sensor developments into the aging management programs that licensees are doing as well as any environmental monitoring programs that the licensees have.

So we will be looking at situations there where we can promote some of these new techniques again in concert with industry collaboration and coordination.

And then with respect to the specific research we will be doing, it will essentially be a scoping study. We will be evaluating critical passive structure systems and components, essentially material aging and then also aging of electrical and instrumentation systems. And then the third area that we will be looking at will be environmental modeling and rad protection.

And after the scoping study, at the end of '09, there will be a research plan developed to identify what areas we need to go into. I think it's worth stating that a lot of this in terms of material

degradation, aging management, most of these issues we are dealing with now.

So, really, all we are going to be trying to identify is if there is anything new between a 60-year and an 80-year life that we need to pay particular attention to or something that at 60 years didn't necessarily cause us a problem, but as we go out to 80 years, the problem moves bigger.

I think about cumulative usage factors for fatigue. That's something we have very conservative regulations in place for. They were generally good enough for 60 years, but some plants ended up being on the margin for extending beyond 60 years.

So that might be an area where it's right for us to go back and say, "Okay. Maybe we do need to look at the conservatism inherent in these and see if there's justification for peeling some of it back."

MEMBER SHACK: Your vessel surveillance programs will presumably need some modification.

MR. TREGONING: That's another area that we need to look at, obviously, because we need to make sure that we have adequate coverage to get us out to surveillance or 80 years. So yes, that's --

MEMBER SHACK: Or if you don't, you have to make some other decisions.

MR. TREGONING: Yews, yes. So that's a --

CHAIRMAN POWERS: You are probably getting much more aggressive than the structured steel research group. I mean, we've got to get those guys on the ball. We need bigger, better, more data. More data, right?

MEMBER WALLIS: What's funny to this program is that in a way, you've got a deadline around 2010 or so. Someone has got to say, "Is the GALL good enough? Do we have to change it? There are some new issues. Do we have to issue new guidance about new problems and so on?"

So there is some sort of a deadline in a way that's there. You have to actually deliver something. It's not as if it's open-ended.

MEMBER ARMIJO: But wouldn't the industry guys have the burden, first of all, from their standpoint to say, "Would it be economical for us to keep this plant burning after 60 years?"

By law, it had better be safe for 60 years. So it is probably going to be safe at 60 years plus a day. You know, there is no cliff there. Why is it --

MR. TREGONING: With respect to their license, it is, though.

MEMBER ARMIJO: For a license, it's a cliff, right. I understand that. But for reality, physical reality, it isn't. Why is it the NRC's role to take the lead on this if the industry hasn't come to you and said, "We really are thinking that maybe we're going to heat-treat vessels." Let's assume that that was a real issue. "And we would like to know what you are going to require for us to prove that annealed vessels will meet your requirements."

MR. TREGONING: That's a good --

MEMBER ARMIJO: Unless they took an initiative, why is the -- and maybe you'll get it when you go out in step two to get input from NEI and the industry, but I just think this is premature. Maybe that's a long way to say I think it's premature, long-winded way to say I think it's premature.

CHAIRMAN POWERS: I mean, he did indicate that they have already had discussions I know for sure. They have had discussions with --

MEMBER ARMIJO: DOE doesn't count. DOE doesn't do that. It's the industry that --

MEMBER SHACK: The licensees have inquired. I mean, you know, it's not --

MR. TREGONING: If I can answer, a) we're not taking the lead because you're exactly right.

It's the licensees' responsibility. And I've talked about the plan focuses on F.Y. '09. There are things we are doing in F.Y. '07 and '08 to identify licensees' intent.

Some of the things that we have identified, March of this year, again, we had -- DOE actually had a joint meeting with industry where they discussed some of these things.

In May, DOE is specifically going to meet with NEI and EPRI. NRC is going to be invited as an observer only, where there is going to be a discussion of intent and technical and regulatory hurdles that they potentially see.

There is also going to be a be a DOE/NRC interagency working group that is going to be established sometime in the Spring, May, June, of '07. And then, finally, in June of '07, there is going to be a DOE workshop on essentially materials under extreme environments. And the technical topics in that workshop, in part, are going to cover issues related to license renewal.

So, I mean, you have got a very fair point. NRC shouldn't be taking the lead. But by the same token, given that we can glean from industry that there is a reasonable intent and a serious intent for

proceeding down this road, we want to make sure we're ready when the applications come in.

MEMBER ARMIJO: You will get a good feeling for that when you get the comments from the external reviewers.

MR. TREGONING: Sure. But, by the same token, they seriously consider whenever they send in a formal letter of intent. So it may or may not be evidenced by a formal letter of intent.

MEMBER CORRADINI: So I just had a quick question.

MR. TREGONING: Sure.

MEMBER CORRADINI: So besides the vessel, can you educate me briefly? You mentioned electrical and instrumentation. Is it electrical cabling? What is the key thing in the aging? I would assume it is the connections.

MR. TREGONING: Cable connections are always an issue, cable insulation breakdown and fire retardation properties as a function of time. Electrical breakers is another area subject to aging.

MEMBER CORRADINI: So, say, the vessel, which you have got to pop a hole in containment, is kind of big. All of these other things, essentially we saw that at least one utility was willing to

rebuild a plant pretty much from scratch with Browns Ferry and unless I misunderstood, in the five percent uprate discussion replace a good portion of what you were talking about, right?

MR. TREGONING: Yes.

MEMBER CORRADINI: So it does come down to potentially just an economic question of how much you're willing to replace versus rebuild.

MR. TREGONING: Sure.

CHAIRMAN POWERS: Well, I mean, I think it is also fair to say that like we did with the PTS rule, NRC may find itself under some pressure to revise its material on aging and the fatigue rules.

MEMBER CORRADINI: Because they may be too conservative?

CHAIRMAN POWERS: They are fairly conservative, yes. And to be fair also, we have encouraged the investment in research fellows into advanced fracture mechanics technologies and things like that so that can do better science in that area and so it's consistent.

MEMBER CORRADINI: Who is doing the advanced fracture mechanics?

CHAIRMAN POWERS: What did you say?

MEMBER CORRADINI: Who is doing the

advanced fracture mechanics, the last thing you mentioned?

MEMBER CORRADINI: Who is doing the advanced fracture mechanics?

CHAIRMAN POWERS: Who is doing the advanced fracture mechanics?

MR. TREGONING: Who at the NRC?

MEMBER CORRADINI: Well, somebody funded by the NRC or at. Just out of curiosity.

MR. TREGONING: We have NRC-sponsored research in a number of ares, national labs, other government agencies, universities. Like many efforts, it is spread around the various agencies. It is not located in one particular place.

And there are a lot of facets because fracture mechanics entails modeling. It entails inspection. And it entails an understanding of material performance.

And when you roll in all three of those components, I would argue that's the majority of the NRC-sponsored material research that we do. It's generally aimed at one of those components of what I would consider holistically an advanced feature mechanic research.

CHAIRMAN POWERS: And all you have to

understand is the answer is always 10^{45} years.

MEMBER CORRADINI: That's the unit?

CHAIRMAN POWERS: Yes. That's the advanced fracture mechanics-issued unit.

An inside joke. Please continue.

MR. TREGONING: I can't comment on that.

Okay. So are there any more questions on license renewal? Because we're --

MEMBER ABDEL-KHALIK: So this research plan that you would develop in F.Y. '09 would be based entirely on the scoping study?

MR. TREGONING: It would be the scoping study would be one aspect of it. Again, it would be based also on where we thought industry was heading and what technologies they may be looking to put in place to support license renewal, but the scoping study would be a major --

MEMBER SHACK: In your proactive materials degradation presumably, there are lots of things feeding into this.

MR. TREGONING: Right, right. Yes. Thanks. I forgot to mention that. That is an important component. And that is one area that we have started to actually do more forward-thinking about material research issues or aging issues than we

have in the past.

So I'm glad Dr. Shack brought that up because that would be a program that we would be looking at feeding quite strongly into the scoping study.

CHAIRMAN POWERS: I will just comment saying that I have lost track of where the proactive materials degradation program is. Rob has assured me that it is alive and well and kicking. I thought it had died a dismal death.

MR. TREGONING: At the risk of getting people upset with me, maybe that's a topic for future consideration.

CHAIRMAN POWERS: That is what I was suggesting to him --

MR. TREGONING: Yes, right.

CHAIRMAN POWERS: -- that sometime we ought to realize that we can do that. We need to go back and reprise the action plan on steam generator tube, put them all together some day.

MR. TREGONING: Well, that could be --

CHAIRMAN POWERS: Just get us up to speed on what is going on.

MR. TREGONING: This could be coupled topics potentially because there's a strong

relationship there.

CHAIRMAN POWERS: Okay. Now the one that I'm really intrigued with.

MR. TREGONING: Okay. Well, I have the honor of presenting this one.

CHAIRMAN POWERS: Yes. Just by way of introduction, though, I really need to understand well how this particular topic interfaces with the Halden program.

MEMBER WALLIS: Why are the two grouped together is one of my puzzles.

CHAIRMAN POWERS: Halden groups them together. So, I mean, it makes sense.

MR. TREGONING: I may or may not be the right person to address that question, but I will at least try to provide some context for how this topic and why this topic made it into the advanced plan.

One of the questions that I think people are going to be asking is exactly that one, how it will interface with Halden and other potentially international activities in this area.

MEMBER CORRADINI: So before you do that, which is technical, explain to me with the attributes we discussed before lunch how it even goes in this bucket. I mean, we said long.

You know what I'm asking? I asked for attributes. And this one kind of surprised me that it is something that is currently. So I didn't think it was going to fall into this bucket. It's an ongoing research.

MR. TREGONING: You're right in a sense. It's not long in the sense of 15 years. The horizon for this is we need to start working. And there is actually a current need.

MEMBER WALLIS: It's being done now, isn't it?

MR. TREGONING: Well, what's being done is we are doing research in the area now. What this is getting at is saying what we could benefit or how this research would be much better organized and structured would be conducting it potentially at a single integrated facility versus what we are doing now spread all around at different national labs, universities, things like that.

MEMBER CORRADINI: So build something.

MR. TREGONING: So build something.

MEMBER CORRADINI: Field of dreams. Sorry.

MR. TREGONING: Yes. That's your words, not --

MEMBER ARMIJO: Is this a pretty expensive facility you are talking about? I would think so. And then rent, operating costs. Who would use it other than the NRC? That's a question. Who else would use it?

MR. TREGONING: And these are all good questions. And given where we are in this, we are at the formulative stages at this point. So all these questions that you all are bringing up are exactly the types of questions that we're asking ourselves now as we debate as an agency whether this is the right thing to move forward with.

So let me start in on the slides. And I think maybe I'll answer some questions. I'm sure I'll raise many others. The objectives of the research are at least -- I say develop, but, really, that is a misnomer. It should be investigate developing a facility for digital I&C systems, which is integrated with a full scale. And a key word here is reconfigurable simulator.

MEMBER WALLIS: I don't understand. I mean, I can understand the simulator facility and you use it for human interactions. Digital I&C systems is something else. Digital I&C systems to me is completely coupled from the simulator.

Question about reliability of digital stuff, how you put in a PRA and all of that stuff. It's quite different from the simulator response, how people use it.

MR. TREGONING: I'll take a quick stab. And then I'm going to defer to Steve. I'll say that there are many aspects of digital I&C which are of concern which we're evaluating now.

But this is trying to get at a specific piece: control room systems, human-machine interface issues. So it doesn't preclude the other research in these things.

MEMBER WALLIS: The I&C systems in the context of the interaction with humans.

MR. TREGONING: Let me have Steve jump in.

MR. ARNDT: Two things for your information. As you may or may not know, we are going to do this regardless because the Commission told us to do it. We have an SRM from them two weeks ago saying, "Go do this"; i.e., investigate the possibility of doing this. That is not to say we are actually going to build it necessarily, but we have been told by the Commission to go investigate the possibility.

Back on the real question you had. The

purpose of this is, at least conceptually right now, one of the efforts we are doing as part of the evaluation is to flesh out what is going to be included and what is not.

The purpose as we see it right now is to take all the different pieces/parts of our research program from a hardware/software and human-system interface and develop a test and research facility.

One of the key ingredients to that is having a simulation capability, not just to simulate the man-machine interface, which is important and has a lot of input to some of the stuff we're doing but also as a driver for the instruments themselves.

One of the big issues is a lot of the digital system reliability and digital system application is dependent upon how you use it, what interface you have with the rest of the system. As Professor Apostolakis likes to call it, the context in which the system is operating.

So exactly how it is going to work we don't know, but the conceptual idea is we are going to have actual pieces of hardware, RPS or control system or whatever. We are going to have the man-machine interface attached to it.

On the other end of the I&C stuff, we're

going to have a simulation of some sort, be it an emulation or formal simulation or just a RELAP model that provides the process variable inputs in a realistic way to be able to drive the I&C.

The Commission has also asked us to say, "Well, if you are going to do all of this, can't you also use it in a traditional simulation fashion for training and things like that?"

And the answer is "I haven't the slightest idea. You told me to go look at it. I'll go look at it." But this concept is to look at how all the pieces/parts fit together to get a good context for which the systems actually work as well as have various facilities available in one place to do I&C testing.

CHAIRMAN POWERS: Said?

MEMBER ABDEL-KHALIK: How would you use a facility like this to check software reliability for an actual system?

MR. ARNDT: There are a number of techniques that have been investigated, primarily in the transportation business, although there have been some other examples that actually go in and look at how the software functions on the hardware and the most popular of which is what is known as fault

injection testing, where you intentionally put a fault someplace in the software or the hardware or the firmware or the communications or whatever and you see how the system responds and then through some rather sophisticated mathematical modeling, you can then back out if there is a fault someplace. And then you sample lots of different places in the system in the state space basically, how would the system behave, and then you back out, well, if there were a fault, it would be this area. If there is not a fault, that you would have this particular kind of issue.

The biggest challenge in software reliability prediction if you'll permit me -- some people don't even like that terminology -- is to, one, figure out how many software faults you have in the shipped system because obviously you would have fixed them if you found them and where are they. And the last part is, what would the effect be if there was?

The one way to attack that is make certain assumptions about how many faults you do have and then look at where they could be and what the effect would be on the outside system associated with it.

This kind of facility would give you the opportunity to have an actual facility to test the equipment and also to look at the outcome of a

particular fault as it propagated through the system and became the software failure and then a system failure and then a failure of some particular action within the emergency response or automated response or whatever.

CHAIRMAN POWERS: When I think about long-term research at the NRC, I have to admit this particular item falls much closer to my definition than the one you have adopted.

You know, if you ask me, how long will NRC be working on integrated digital I&C and human-machine interfaces, I would say, how long is the agency going to be here. The issues never go away.

And both the machine part and the digital I&C part are evolving dramatically. The human part I think is relatively fixed from an evolutionary point of view, but it's not fixed in a cultural point of view. And we have learned that culture affects things. And so this goes on forever.

The challenge that I encountered when I saw your SRM comes from my experiences on this Committee. For some sin that I committed in an earlier lifetime, I inherited the Human Factors Subcommittee for some period of time and was intrigued by the activities going on at Halden and found that

fairly unpersuasive, but the insistence was this was exactly what that facility was intended to do. And, indeed, they do a lot of things. Since that time, I have become more enthusiastic about, well, I think I have some appreciation of its defects.

So the question I guess I wanted to pose to you collectively is when you are looking at these options that are before you, is among those options enhancing the Halden facility, upgrading its mission, and whatnot, which is, to be honest with you, somewhat static? They went through an upgrade, what, ten years ago or something like that.

On the other hand, I've also been told that the simulators down in Chattanooga are, in fact, under-utilized. And so is upgrading one of those in the options phase here?

MR. ARNDT: Okay. One thing I will mention, as we found out we were getting this SRM, we went back and changed the documentation you have. I think we got it in two out of the three places.

I was rereading it this morning. The Commission has told us to do this study this year and give them results in December. So I think we caught that. I think there is one place where it still says we're doing the study in '09, as opposed to maybe

starting to build it in '09.

The Commission when they asked us specifically to look at a bunch of different issues -- there are I think 11 different issues they want us to look at. One of those issues is how this would relate to ongoing existing facilities, like Halden. Another was how we would possibly site the facility associated with other joint facilities like the Air Force has a very similar facility to this kind of thing at Wright-Patterson Air Force Base and the Armstrong research facility.

The Transportation Safety Administration has a similar kind of facility. So one option would be collocated at one of those kind of facilities. Another option would be to collocate at our Chattanooga training and simulation facility because the overhead associated with having simulation capability, I&C capabilities, human factors capability is very significant. And to collocate it at some place that already has some of the infrastructure associated would be a significant savings.

This is somewhat different in two respects from Halden. One, it's in the United States. It's not located someplace where we have to do foreign travel, et cetera, et cetera, et cetera. So there is

some significant potential advantage.

And if you actually look at the SRM, it doesn't say an integrated digital I&C human-machine interface research facility. It says a U.S. integrated digital I&C, specifically talks to that issue. And there are some obvious advantages to that.

The other issue is associated with the Halden facility. And most of the facilities associated with these kinds of things are primarily looking at the back end, the human-machine interface issues.

This facility is to be certainly look at those issues but also primarily look at the integrated truly I&C and human-machine interface stuff. Most of those facilities look primarily at the human-machine interface and the displays and things like that and much less at how does the actual I&C system work.

This is going to look at that, maybe 60 percent I&C and 40 percent human factors, as opposed to 80 percent human factors and 20 percent I&C, and utilize things like simulation, like testing strategies and things like that of the actual hardware.

As you know, our I&C regulatory structure is primarily document-based. We do almost no testing,

and we review almost no testing. This would hopefully put I&C on the same kind of paradigm where we would do more testing and analysis like severe accidents and thermal hydraulics and other things in the agency.

Is that sufficient?

CHAIRMAN POWERS: Well, I have heard your answer. And the time for debate on that answer is some other forum, I think. At least I have heard your answer. It was a very good answer.

Bob?

MR. TREGONING: I think Steve actually covered the rest of the slides.

(Laughter.)

MR. TREGONING: So I want to thank Steve for not saying anything particularly egregious. So the only thing I want to mention, again, the plan itself focused on F.Y. '09. Steve talked about what is going to be done before that, including this detailed option paper.

We have a commitment to provide it to the Commission in early F.Y. '08. I believe it's December of '07, so at the tail end of the calendar year.

And there is going to be a lot of work in terms of a workshop prior to that where some of these questions that Steve talked about get flushed out and

asked to the community at large. And then the staff is going to come forward and propose some options.

And at that point we will have a much better understanding of potentially where we're going to go with this, if we're going to go with this. And pending Commission approval, that will really define, then, what we will be doing and what sort of research plan we will need to develop so that we are ready in '09, as Steve said, to actually start down the road of implementation of this facility, again, assuming it will come to that.

MR. ARNDT: Potentially.

MR. TREGONING: Any other questions before we move on to the next topic?

CHAIRMAN POWERS: Go ahead.

MR. HELTON: The next topic is integral effects test facilities for advanced non-LWRs. The objective here is to, at least in fiscal year 2009, identify the availability of facilities that could be used to perform testing.

And this could in some ways overlap with what Dr. Powers brought up earlier, the fact that, for example, with liquid metal reactors, there is experience, past experience, with similar designs. The same is true for high temperature gas reactors.

Early LWR experience has demonstrated that integral testing is necessary in some areas. This is an attempt to identify that same sort of need for advanced non-LWRs for purposes of ensuring the adequacy of the safety criteria that we're using for evaluating the tools the licensees are using, to build their safety case, and also to develop our own tools as necessary to do independent confirmation.

I kind of already covered what we would do in fiscal year 2009. That would be to identify the availability of facilities and at the needs that are there in the different disciplines.

This is somewhat unique from some of the other things that we will discuss today in the fact that it looks at pretty much every discipline that this agency has to worry about. So we would be looking at severe accident issues, risk assessment issues, materials issues.

Pretty much across the board we have to consider and look and see what needs are out there and see what integral effects tests we think need to be run to get at those issues.

MEMBER WALLIS: What sort of tests do you think? Are you thinking of something like a LOFT test or something like an APEX test on --

MR. HELTON: I think those are both good examples of the types of things we're thinking about and that those are both integral effects tests. I don't know that we know specifically at this point what we're --

MEMBER WALLIS: You wouldn't be building anything yet? You would just be planning for what you would do, which would include identifying available facilities or if we think there is an area where there is no facility, then identifying that area and developing specs on what type of facility you might need?

Certainly facilities like APEX and others, PUMA, and a lot of the facilities we have used for operating new reactors to the extent that they can be modified to study these issues, there's clearly gain from that.

MEMBER ARMIJO: Now, is DOE putting together a similar list of facilities to support their advanced reactors?

MR. HELTON: I would presume that they are, but I am not speaking from an expertise there.

MEMBER ARMIJO: Yes.

MR. HELTON: I am not sure.

MEMBER ARMIJO: Well, my opinion having

worked in LMR work is that U.S. test facilities for doing that kind of work are in pitiful condition, sodium test loops, no fuel testing capability. You name it. And I would think the NRC -- that's not your charter, but somehow you would integrate the Department of Energy.

As a nation, if we are going to do these kinds of things, we had better have adequate development facilities as well as regulatory support facilities. I would urge you to work with DOE on that to make sure that you got a comprehensive list.

MR. HELTON: Absolutely.

CHAIRMAN POWERS: My understanding -- and, again, I'm far from an expert on this -- as the casual pedestrian in this field is that, in fact, DOE has looked -- the partnership, the Global Nuclear Energy Partnership, is, in fact, making use of a large number of foreign facilities for doing a lot of the testing.

MEMBER ARMIJO: That's a goal, but I am just telling you that, as far as I know, the U.S. doesn't have one sodium loop of any quality.

CHAIRMAN POWERS: And I think that is true.

MEMBER ARMIJO: That is kind of pitiful.

CHAIRMAN POWERS: But the objective is

okay. We don't. So don't build one. Go use somebody else's. And, now, I do know that in the area of neutron irradiation capabilities, that that has become a real crisis as far as the availability of resources, though our Russian colleagues seem to have an infinite number of facilities of that type and are anxious for you to make use of them.

MEMBER ARMIJO: Yes. All of that just takes times, takes money. If you are really going to be serious about this stuff, you had better invent as a nation or, else, it is going to be a flop.

MEMBER CORRADINI: So just to follow up what Sam was saying, I guess I might ask the question a bit differently. With the EPAC 2005, where it says, at least for the gas reactors, thou shalt work together, I am assuming that you will actually be in communication with DOE about facilities that might be jointly shared so that if you need to do something, there would be one investment and certain experiments would be done at DOE relative to what they need to do for fuels development and, conversely, if you need something for safety so that there is some collaboration in that regard, at least from a facilities standpoint.

MR. RUBIN: Can I just address that? Stu

Rubin, Office of Research.

With regard to dealing with DOE on very high temperature gas reactor technology R&D issues, we are very much working closely with them ever since we signed the MOU to get going on the licensing strategy. And some of the recent work, as many of you know, involved conducting PIRTs in a number of areas.

And part of that exercise is not only to identify important phenomena but to identify gaps in the data that exist today and how to get that and where you get that and what are the research facilities that you would need to utilize to get that data. And we're jointly identifying those gaps.

And our expectation is that the applicant, DOE, the designer will have the first responsibility, primary responsibility, to develop that data. But that doesn't rule out the possibility that we may use that same kind of facility to conduct somewhat different testing to address issues that we may have that they feel are not valid, but we may want to test at those same facilities to validate or invalidate our concerns.

So in terms of identifying the spectrum or suite of facilities, yes, we are working very closely with them on the gas reactor arena. In terms of the

fast liquid metal reactor arena is concerned, we are just getting started with that.

MEMBER ARMIJO: That sounds like what I would like to see you do because --

MR. RUBIN: Yes, yes.

MEMBER ARMIJO: -- I think that is the only way that --

MR. RUBIN: We are following both the licensing strategy, which mandates that, and another section of APEX, which calls for DOE and NRC to work together to make sure the technology is safe and licensable, which gets at this very question.

MEMBER SHACK: Does your advanced reactor research plan include source term work?

MR. RUBIN: Yes, it does.

MEMBER SHACK: It does?

MR. RUBIN: That is an entire arena, a source term in all of its piece/parts starting from the fuel kernel all the way out to the release from the reactor building and all of the pieces, barriers that are associated with that pathway.

CHAIRMAN POWERS: They produced a monumental thing on just the release from the PIRT.

MR. RUBIN: From the fuels part alone, we had dozens of phenomena that we are aware of.

CHAIRMAN POWERS: They just went through an exercise on the subsequent, you know, after it has been released, now what?

MR. RUBIN: Yes. And, by the way, in all of these exercises, we identified the gaps. And those gaps don't come as any surprise to the vendors because they know that they have a technology development requirement to actually develop that data to fill those gaps.

MR. HELTON: Thanks, Stu.

Unless there are any additional questions on that topic, we can proceed. I think the next one is one that may be near and dear to several of your hearts. And that's the issue of advanced computational methods. This to some extent deals with what Dr. Powers mentioned earlier about getting fast learning tools in the hands of people to be able to use them.

The agency does obviously a fair amount of work in computational analysis. And primarily on a discipline-specific basis when there is a need to incorporate improved numerical methods or improved uncertainty methods, those are obviously pursued.

What this is attempting to get at is looking at things a little more generically and trying

to look at the internal and external computational environment changes that have transpired over the previous years and to identify any technologies that might be useful to multiple different disciplines and the computational tools that they use. Obviously if as part of this we identify discipline-specific areas for development, we would obviously pursue those.

The main focus, I think it would be safe to say, would be on the numerical methods, sensitivity analysis techniques, the uncertainty analysis techniques, and the ability to do system simulation.

So fiscal year 2009 we would be looking at a scoping study to identify what is out there, look at what we currently do, and see if we can't map out some areas where we could get some good improvement by taking the logical steps.

MEMBER WALLIS: Are you thinking of computational methods which might be used in research for dealing with, say, a big problem? Are you thinking of something which might be on the desk of everybody in NRR? What level are you thinking of here?

MR. HELTON: I would say at this point neither one of those is outside the scope. We're pretty ambiguous at this point intentionally so that

we could consider both of those certainly. Things like solving large matrices in systems codes is one of the things we would be interested in, but also the issue of software developments that would increase portability would be an example of improvements in getting the --

MEMBER WALLIS: Let's say that an NRR guy is reviewing some new reactor type, he wants to look at accident scenarios. Is there some way he can call up something on his computer and run it and see what it looks like, instead of just reading a document and imagining what might be happening? Is that the kind of thing you're thinking of, a tool for use by people or is it --

MR. HELTON: I would say as this part is currently laid out, we're not specifically looking at that. Clearly we could broaden the scope if need be. We have mainly focused on developments that could be used for our existing tools.

CHAIRMAN POWERS: What Professor Wallis discussed is the tool in NRR, it's certainly the thing that the ACRS had in mind when it wrote its research report. I see this as distinct from that and a viable thing.

It strikes me that you have focused very

much on the mathematical aspects of the model of computation here and not so much on the hardware. And you might want to consider broadening that.

I suspect I related before I was asked to look at the issues of computational capabilities more than numerical methods also of hardware. In pursuit of that, I found that today if you ask for a standard engineering computational capability, just ask somebody to set it up for you, that it would be a 64-bit processor, I mean, 64 processor installation, with about a megabyte of memory per processing and things like this, huge capability beyond a PC, and that a standard capability would be a virtual reality CAD CAM type of capability.

So that you would draw the thing. You put on a little helmet. And then you get to walk through it. Instead of looking at a screen, you kind of feel like you're walking through it. And they're all very spectacular when you do that.

And I would certainly anticipate that those kinds of things would be adherent in any reactor that was designed, say, in the era of 2020, that what they would bring to the NRC was something that was designed with these virtual reality kinds of approaches to that, as opposed to the kind of

two-dimensional world we live in and computation. So you might want to think about broadening it just a little bit.

MEMBER CORRADINI: On the other hand, though, we might have to go visit it.

CHAIRMAN POWERS: What did you say?

MEMBER CORRADINI: He would submit it. We have to go to visit it. There would be the PRA in there. We can go to the cave. We can go to the PRA.

CHAIRMAN POWERS: I mean, that's kind of what's done. I mean, the people I was looking at, I mean, they certainly put on demonstrations for me. And among the things that I got to do was to walk through a digital circuit in this virtual reality.

And their argument was the computational force was probably so great that there was no way for a human being to assimilate the output in any graphical form.

But in this three-dimensional where you can walk kind of where you wanted to and they would change colors when there were stresses on contact points and things like that, you could see and identify. You could assimilate better in this three-dimensional visual than you could in any two-dimensional screen. And so it was a tremendous

design tool.

But, I mean, my thinking here is what kind of application am I going to get in 2020? It's clearly going to be designed in this kind of technology, not in the kind of technology that I would design one. And it's going to be designed by people with a much greater facility in using computers in that way than I certainly have.

Go ahead.

MR. SIU: If I may, I mean, those are certainly excellent points. I think some of our thinking here was a presumption that the hardware and software would be tremendously advanced and would allow us to do things that we're currently not doing.

So the tablet PC walking through as an inspection tool, we didn't write it in here. And I think that is a good thing to do. Certainly in terms of, for example, system simulation, even now people talked about a desire to have that one. They were talking about manual actions for a fire. And if they had a little simulation tool, they just sketch up. And they say, "Well, this is feasible or not." That would be one way of addressing the problem.

And then, of course, there are the far more complex simulations: linking operators and

thermal hydraulics and plant hardware all together in one big nice tool that may be impractical by that time.

CHAIRMAN POWERS: Even in the area of safety and safeguards, one on one course drills, at least within the military complex, right, which I spend most of my time in, --

MR. SIU: Yes.

CHAIRMAN POWERS: -- actual warm bodies out shooting at each other in exercises is only a vehicle for benchmarking and standardizing. Most of them are done via computers nowadays. And they are very realistic. I mean, they are maybe not quite as good as the latest Sony Playstation but pretty damn good.

MR. HELTON: Thanks. Those are all good points. And I think, Dr. Wallis, we will certainly look at revisiting the scope of that and see if we shouldn't be looking more specifically at some of those topics.

MR. TREGONING: If I could jump in quickly, Don, at least with the New Reactor Office, for instance, these are questions that they are asking every day now because they are trying to look at how they can make their process for licensing more

efficient.

And they're looking at and they're investigating the use of having intelligent reviewer tools, which is what they would call them, which is essentially at the fingertips of the reviewer all the information that they need for the system that they are looking at.

And we are nowhere near this 3-D holistic walk-through of the system that Dana is talking about, which would be fabulous, obviously. But they are talking about incorporating things in one convenient source, such as the appropriate regulations, the technical basis documents, drawings, PRA insights, and even a level of I'll call it advanced knowledge management where insights from sort of the old guard of reviewers are passed down to the newer guards, even qualitatively or semi-quantitatively. So those kinds of questions are being addressed. And it's something that some of the user offices are looking at actively now.

And that is an area that I would anticipate as they find areas where they think research needs to contribute to the development of those tools that they will certainly call this in.

CHAIRMAN POWERS: In the weapons complex

again, just where I spend my time, that old guard to new guard is exactly why the old guard has gotten very enthusiastic about these computational methods is that they see the old guard will learn by the apprentice program. There is no apprentice program to bring you people in. So you bring them in a virtual master that the young people apprentice to.

And the truth of the matter is, quite frankly, our children are so much better at using these computer game-type tools than you and I will ever be. But that is kind of what they have come to expect to have available.

MR. HELTON: Okay. We will move along. The next topic is multi-phase computational fluid dynamics. The goal here would be to extend the agency's current capability, which relies mainly on single-phase computational fluid dynamics, into a multi-phase capacity.

We are starting to see the use of multi-phase CFD in other industries. We are also starting to see interest from the nuclear industry and using it during some of its licensing actions.

MEMBER WALLIS: You might be better to take something commercial. It's a major task to doing it yourself.

MR. HELTON: I'm sorry? Could I --

MEMBER WALLIS: A major task to develop such a thing yourself, but you could take something commercial and adapt it to your needs.

MR. HELTON: Correct. We would actually look at both options. There is the option of developing a research tool or using a previously developed research tool. There's also the off-the-shelf approach with single-phase CFD capability. That's the main tool that we use is Fluent, which is an off-the-shelf tool.

Both sort of have some of their own nuances. The off-the-shelf has a lot of benefit from the standpoint of the development that's already been done, but you can run into issues with it not being benchmarked for the types of problems that we want to use it for.

So there still would be work to be done, even with an off-the-shelf code, to demonstrate that in high-pressure nuclear reactors, its constituent models are behaving appropriately.

But you're right. Those are both viable options. And those would be considering both.

MEMBER WALLIS: This would be, what, a two or three-man operation or something order of

magnitude?

MR. HELTON: Yes, that is the right order of magnitude. Right now we have approximately three people in the Office of Research who do single-phase CFD. They occasionally go off and do other things as well. But that is the right order of magnitude for where we are at with single-phase. And I would assume that we would be on the same order of magnitude with multi phase.

MEMBER ABDEL-KHALIK: Both Fluent and STAR-CD have limited two-phase capability. Have you sort of examined what the capabilities are in the commercial codes?

MR. HELTON: You mentioned STAR-CD and Fluent. They both do have one or two-phase CFX, which is the third commercially available or most popular, so to speak, commercially available code, also has two-phase capabilities.

We have looked at those tools to some extent, but that's primarily what we're looking at doing in fiscal year 2009, is exactly that, examining what areas these codes can perform well in, where their models will hold up for our applications and where they won't.

All three CFD vendors, of the three that

we've mentioned, all three have expressed interest in the nuclear industry and in getting engaged in the nuclear industry to varying extents, but still their main driver for model development is the automotive industry, the oil industry, and the chemical process industry. Some of the models that they are developing are applicable for us, and some of them aren't.

Sorry. That is a long answer to a short question.

CHAIRMAN POWERS: Given your criteria that you laid out before, I can certainly see why you would pick this one up here. I mean, it's an emergent technology that has some applicability. So don't fault that. And what you planned here seems appropriate.

What a little bit puzzles me is it comes down after you have completed your first activities. Somebody is going to ask you "And what are you going to use this for?"

It's not quite clear to me the advanced reactors that get talked about are all single-phase systems, thinking about gas-cooled reactors and sodium-cooled reactors and lead-bismuth-cooled reactors, and molten salt reactors. The kind of advanced reactors, you know, the EPRs and the ESBWRs

and things like that, are all going by regulations that really don't require CFD cleansing modeling, it seems to me.

So what is your thinking? Again, I don't fault the words that you said.

MR. HELTON: No. That's a good question. From the advanced reactor side, I am not going to go too far down that path because I will quickly out-talk my knowledge, but certainly --

CHAIRMAN POWERS: Mine, too. So.

MR. HELTON: -- airing egress, you can get in accident conditions where you might have a two-fluid system.

MEMBER WALLIS: More than two fluids.

MR. HELTON: More than two fluids?

MEMBER WALLIS: Solids and all kinds of stuff will mix up.

MR. HELTON: With the new reactors, EPR, ESBWR, those that you mentioned, in a lot of respects, they look a lot like the operating reactors. And we see single-phase and we see two-phase CFD or requests coming in that we are not able to address when conditions arise that you need to know the thermal hydraulics better than a systems code can tell you.

An example of this in the single-phase

world is the steam generator tube rupture work, where folks are interested in mixing in the inlet cline and the entrainment and the hot leg and the types of things that systems codes struggle with developing flows, those types of things.

So we foresee that there will be those types of applications.

CHAIRMAN POWERS: And that's good enough for me. We don't need to go to the specifics.

MEMBER WALLIS: Major accidents where you actually get fuel damage, then you get into an area where things are flowing and you can't predict ahead of time.

CHAIRMAN POWERS: It makes no difference.

MEMBER WALLIS: Oh, no. I think if you get --

CHAIRMAN POWERS: No. It makes no difference at all.

MEMBER WALLIS: Why not?

CHAIRMAN POWERS: Once you get into a similar accidents base, if you can balance heat and mass, you've got a --

MEMBER WALLIS: And that's good enough?

CHAIRMAN POWERS: It's good enough.

MEMBER WALLIS: You really need to know

where things go, don't you, as well?

CHAIRMAN POWERS: It's good enough.

MEMBER ABDEL-KHALIK: But industry, I mean, is already moving in that direction in some applications; for example, modeling of crud deposition in BWRs. The robust fuel program of EPRI is doing just that, trying to develop CFD modeling capabilities that would allow them to get a better sort of prediction of what happens in that particular application.

MR. HELTON: Right. And that type of thing -- we talked about the aspect of the NRC having the capability to do this type of analysis for when confirmatory issues arise. Something that we have also seen in the single-phase CFD area is licensees will submit applications that rely on CFD analyses.

And we need the technical capabilities, technical expertise on hand at staff to be able to consult to the program offices during those reviews and make sure that they're using the appropriate models, that they're using the appropriate nodalizations, that --

CHAIRMAN POWERS: Because it is incredibly easy with these CFD tools to fool yourselves.

MR. HELTON: They will make colorful

pictures very quickly. The trick is to make accurate colorful pictures.

CHAIRMAN POWERS: Professor Wallis, in fact, showed me an example of in the automobile industry they were modeling a car in a wind tunnel and that in the absence of experimental data, you couldn't tell anything. But after repeated experiments and much, much data, eventually a car emerged in the flow pattern.

It was a true edification of me to how easy it is to get a result that you like and quit the CFD. And so confirmatory work by the NRC is demanded.

MEMBER WALLIS: But you can still make a regulatory decision, whether it has anything to do with reality or not.

CHAIRMAN POWERS: The difficulty I see -- and the people in this agency are more familiar with it perhaps than I -- is that when things come out well, there is a tendency not to look in detail. And it's only when things come out badly that people will plunge into the details.

So I understand why you are interested. Thank you very much.

MR. HELTON: Obviously this is my area. So I can talk on the --

(Laughter.)

CHAIRMAN POWERS: I didn't realize we were talking to an expert here.

MR. HELTON: I wouldn't go that far, but obviously we should press on.

CHAIRMAN POWERS: Now, I will comment that among my colleagues who can actually spell CFD reliably, that they are fairly abusive toward the commercial tools. In other words, I suspect there is a next generation of computational tool coming along that will be much superior to Fluent and CFX and things like that.

MEMBER CORRADINI: No. Actually, they are all being combined and bought. So no.

CHAIRMAN POWERS: These are research tools that are fairly impressive. I know Nathan probably knows more about them than I do because I think they have been used in some of these security studies for dispersal of liquids and things like that.

MR. SIU: When you take a CFD code that's the general purpose and apply it to a fire, for example, you know, you may be going in a different direction I think than what Don was talking about.

MR. HELTON: The next topic is advanced modeling techniques for level 2 and 3 PRA. The idea

here would be to provide an integral, quantitative, and predictive capability to support level 2 and 3 PRA. This would provide an alternative to the accident progression event tree approach.

A number of phenomena based on the sites have been incorporated into the agency severe accident code MELCOR as a result of significant severe accident research that has been done over the past 20 years. Meanwhile, the current level 2 treatment relies on some simplifying assumptions and simplified approach.

Your uses for this would include the possibility for eliminating reliance on simplified LERF, the ability to do quantified level 3, and the ability to look at alternate risk metrics.

In fiscal year 2009, we would look at developments specific to the MELCOR code that would allow it to be used in this type of environment. Those would focus on making modifications that would make MELCOR faster running so that you could study multiple cut sets and also any issues that would arise in terms of incorporation into a level 2 and or level 2/3 PRA.

CHAIRMAN POWERS: Are you familiar at all with this work that has gone on at Ohio State on the accident progression event tree formulations?

MR. HELTON: I personally am not.

MR. SIU: Are you talking about the work by Professor Aldamir?

MR. HELTON: Yes. Yes, yes, yes. In fact, I think he's working with Sandia on part of that LDRD that's looking at a general purpose simulation framework. I think it uses MELCOR as the underlying engine.

CHAIRMAN POWERS: It may, but it is more the philosophical approach. The problem that we had in 1150 with the accident progression event trees is they were damn difficult to put together. They required about one man-year each.

They're static. And once you put them together, nobody, nobody, wanted to touch them, regardless of what the analysis said. And what all the mirrors come up with is a dynamic way of doing it.

So it takes out the human element, a lot of the human element. You don't get rid of the human element ever, but it gets out the grunge. And you can do the accident progression event trees dynamically. And that alone will go a long way to accomplish the results you're talking about here to being able to do multiple risk metrics, multiple level, multiple consequence kinds of things.

MR. HELTON: If I may, yes. The area of dynamic PRA, called I guess by the folks who have been working on it, has been around for several years. And Professor Aldamir is following on particular approach. It is a disketized approach.

I'm not saying it's a bad thing to do. My understanding of what this proposal is talking about is more of a direct Monte Carlo formulation, which is similar to what the Germans are doing now with MCDET.

I was just told, in fact, a couple of weeks ago that they built an operator model into that code, which is interesting to me. I didn't realize they were pursuing that.

So there are developments going on. Now, there are some real interesting issues that one would have to address as you start bringing it into applications such as decomposing the results once you got them, figuring out what is important, reviewing the results, treating uncertainties, which on top would be the stochastic model that you have built in, and doing that with your computational budget. So I think there are some real challenges. But in principle I think it is a good thing. And then what they are doing I think is --

CHAIRMAN POWERS: With these advanced

techniques, it's real easy to get trapped into, well, it's very difficult to apply it when you forecast way ahead. And so you kill a baby before he even gets a chance to crawl, let alone walk. And you have to be more gentle on these techniques.

I don't presume to have any expertise here, but yes, this is all very consistent with the idea of taking greater use of PRA in a more dynamic sense and even consistent with the idea of having it at the analyst's desktop eventually.

MR. HELTON: And better integration of physical models with the PRA, eliminating some of the intermediate modeling assumptions you have to make, like success criteria.

But, again, there are disadvantages as well. We have to -- Charlie?

MR. TINKLER: You mentioned in your last --

CHAIRMAN POWERS: Charlie, identify yourself. Go to a microphone, please.

MR. TINKLER: Charlie Tinkler from the Office of Research.

Nathan mentioned in his last sentence or two "In addition to the direct application for quantification of damaged states, it is also

envisioned that integrating this more rigorous simulation and quantification would have direct feedback on the level 1 aspect of the PRA."

We see lots of potential for improvements to the level 1 just by incorporating transient simulation of systems response. You know, our generalization might be that the use of the static criteria for assessing success criteria in terms of core damage has led to, at least in some cases, considerable conservatism in the level 1 evaluation of core damage frequencies.

MEMBER WALLIS: If you could do that, then you wouldn't need to have such artificial design basis accidents because they would actually be more realistically modeled in the PRA itself.

MR. TINKLER: And I guess, in part, when we talked about this originally and perhaps still, we saw this modeling as having the potential to significantly inform how we regulate in general and would have cross-cutting -- I guess is the term -- applications to design basis analysis or what we currently think of as design basis analysis.

MR. SIU: If I may, one other point. Charlie mentioned level 1. One of the reasons that these techniques, we started looking at them in the

first place was we thought this would be one way, maybe the only formal way of getting at errors of commission to start setting up the context by which the operators are responding to.

Now, of course, the computational complexities in doing that and empirical data requirements are pretty stiff. But, again, we're thinking of a long-term program that would end this scenario.

CHAIRMAN POWERS: It wouldn't hurt justifying this work by discussing exactly that. And it doesn't hurt to emphasize "Yes, this may take a lot, but when you're talking about long-term research, a lot is what you're talking about." So that's not a deterrence. That's a reason for making it a long-term research project.

MEMBER WALLIS: I am happy that Charlie spoke up because what I am missing from almost everything today so far has been the presence of some sort of advocate who has a vision for what he would do if he got this award to do the stuff. And here we have someone who seems to have a vision of what he might actually do. And that has really helped me. Some of these other things you have identified a need, but we don't have someone who has got the picture of

how he would actually fulfill it.

CHAIRMAN POWERS: The room isn't actually big enough.

MEMBER WALLIS: The room isn't big enough? Maybe there aren't too many of those people around.

MR. HELTON: If there are no other questions, we can progress to the next topic. That topic is advanced off-site consequence code. The objective here would be to identify whether the time is ripe to develop the next generation code.

The agency for reactor accidents currently relies primarily on the MACCS2 code and the RASCAL code. Those, both codes, employ some simplifying assumptions in terms of the way that they treat various aspects of their modeling, the most notable being the Gaussian plume or the Gaussian puff depending on which code you are talking about modeling atmosphere transport. And both codes are being evolved as time and resources permit, but there are limitations based on their original code architecture in terms of how much they can be involved.

So the idea here would be to identify whether or not the time is right to step back and start down a new path with a code architecture that would allow us to implement some of the advancements

that we see that are not able to incorporate.

So, with that in mind, fiscal year 2009 activities would look at the currently available modeling techniques that are out there but are not implemented.

MEMBER WALLIS: Would these be site-specific? I mean, if you have a mountain close to the reactor and you have a prevailing wind, you often get wakes from the mountain and stuff, which are quite different from the kind of turbulence you just assume just from some kind of CFD model. And they are very site-specific.

MR. HELTON: Certainly the idea would be to incorporate site-specific information.

MEMBER WALLIS: Okay.

CHAIRMAN POWERS: When these issues of consequence modeling have been broached, I often hear people say the Europeans are much ahead of us in this modeling. Are they? And do they have anything to offer?

MR. HELTON: Let me answer the second one of whether or not they have anything to offer. Certainly that's one of the things that we will be investigating. We will be looking at what other agencies in the U.S. government are doing. There are

a number of different agencies that have interest in this particular arena and certainly also what the Europeans are doing.

I am not familiar with the specifics of where they're at. I don't know if Jocelyn wants to address that question. I think she does.

MS. MITCHELL: Jocelyn Mitchell from the Office of Research.

The Europeans are not supporting any development in off-site consequence code. As a matter of fact, on a weekly basis, we get requests, queries from the Europeans, who used to use COSYMA, to find out what we're doing in MACCS because COSYMA is just not supported at all.

So I'm trying to find out what the Japanese are doing because there may be some things in OSCAAR that may be of interest to us. But the Europeans are not there.

CHAIRMAN POWERS: Thank you.

MR. SIU: If I may, also I'm under the impression that there are a tremendous number of codes out there. Different organizations have their own favorites.

So, in fact, there was a program. I think it was a European program called an ensemble where the

idea was to, rather than fix on the best code, just say, "Well, here is the range of code predictions. And now we'll give that to the decision-maker and let the decision-maker figure out what to do with that." And you can imagine sometimes that that leads to a very tough decision.

So, again, it didn't seem like they were converging towards some super version.

CHAIRMAN POWERS: Thank you.

MR. HELTON: Okay. Rob?

MR. TREGONING: Okay. Moving on to the next topic, on slide 30, this one is on advanced fabrication techniques. This is a topic area that really stemmed out. DOE has been looking at this for some time. And it's in concert with their MP 2010 program, which one of the objectives for that when it was established back in early 2000-ish time frame, maybe 2002-2003, was to look at what needed to be done to speed technologies for the new reactors. And the target for them was construction at the time in 2010.

So the objectives of this research program are to evaluate the performance of new construction fabrication and manufacturing techniques, specifically within nuclear applications. And then a corollary piece of it is to assess the use of performance-based

versus prescriptive-based specifications, what we used historically for the past generation of power plants.

One of the things we know -- and DOE has been active in this in considering and advocating new techniques for construction of the next generation of plants -- many of the techniques that are being looked at have tremendous economic benefits; i.e. they let the construction occur more rapidly, fabrication occur more rapidly, hence leading into a greater economy of scale in the production of these plants. Several techniques also beyond just having economic incentives also are promoted in some cases as significantly improving the quality of the final product itself.

The other trend that we're seeing, especially in the concrete area as well as other material areas, is that industry is moving again from these prescriptive-based specifications to performance-based specifications.

One of the things we're trying to assess here in this program is we have seen application of some of these techniques overseas in nuclear construction. We have seen applications here in the U.S. in some cases for larger projects in other sectors, like shipbuilding, civil works, fossil fuel plant construction. We want to try to understand. We

want to learn from those experiences. But we also want to determine if there are some unique nuclear challenges that we may be facing.

DOE actually commissioned -- they have commissioned several studies on this. And one of them looked at technologies that might be applicable to a number of the new reactors. They looked at ABWR, ESBWR, AP1000, and ACR700. And they evaluated 13 technologies that they thought may be applicable to those new plants.

Nine of the 12, at least by this DOE study, were indicated that they were sufficiently mature and there were no technical hurdles for their implementation. At least the recommendation is that vendors and licensees look at proceeding forward with these.

There were three other areas that they said were viable and could offer tremendous advantages, but there were some technical hurdles.

MEMBER WALLIS: This isn't just at a microscopic scale, steel and concrete. This presumably is also how you put together an I&C system itself.

MR. TREGONING: Yes. Some of the areas that they looked at if I can run down a quick list

were concrete composition technologies, high deposition rate welding, robotic welding, 3-D modeling.

MEMBER WALLIS: Those are big things?

MR. TREGONING: Big things, GPS applications and construction, open top installation, blasting rock removals, pipe welds. Now we're getting at some of the ones -- these are the three that they think some more work is done in: prefabrication, preassembly, and modularization; cable splicing; and then the one that I think you're getting at is advanced information management and control.

MEMBER WALLIS: Thank you.

MR. TREGONING: So a lot of these are focused on the macro-scale construction, but they did try to span a variety of scales there.

So uses of this research. The uses of this are quite obvious. We would be using these to support staff review and development for any updated guidance that's necessary so that we can review and make sure that new nuclear plant construction is going to be adequate, especially when these new techniques are proposed.

So this is an area where, again, we're focusing on '09 in the research plan, but we really

anticipate activities prior to '09 to help us develop a road map for where we need to head in this area.

And what we're planning is that in the nearer term, F.Y. '07-'08, we're going to be coordinating with DOE and the industry to identify --

MEMBER WALLIS: Does this have a regulatory side to it? I mean, you are going to regulate how these build these things? Is that the idea? You are not going to build them yourself. You are not going to design anything yourself.

MR. TREGONING: Right.

MEMBER WALLIS: But you are going to have to make decisions about how they are allowed to build them? Is that what the idea is?

MR. TREGONING: Yes. We found design certifications in the new plants. Now, in some cases part of that design certification process had dealt with aspects of construction; i.e., if they're planning to use a new containment that has an integral form so steel on both side of poured concrete. There has been some evaluation of that design, of that structure so that we can make design certification decisions.

Other things, though, we have left open. and we have said you need to demonstrate in your

construction that your piping system is going to perform adequately. Now, they may not have necessarily needed to specify how they are going to fabricate those pipes. They may have or they may not have.

One of the open items in the final licensing is the licensee has to come in and demonstrate that how they have done the fabrication in the construction of the plant is adequate.

So what we would be doing here is making sure that staff has the sufficient technical expertise and tools at their disposal so that they can evaluate these proposals as they come in.

So, again, prior to '09, we will be looking at coordinating with DOE and industry to identify what particular techniques they may be specifically interested in using. We will be assessing any technical and regulatory issues associated with those techniques.

And then, at the risk of being repetitive in '09, we will be conducting another scoping analysis to identify and prioritize those technical issues which have been identified and really try to focus on those that may have adverse safety ramifications. And we will also, like I said, be looking at evaluating

the use of performance-based specifications.

And then based on this interaction and evaluation, we will be developing a detailed research plan to identify those areas, those technical issues that we need to put more defined and specific resources to make sure, again, that we have got the tools available to support the licensing decisions that need to be made.

Any questions on this one before we move forward?

(No response.)

MR. TREGONING: The next one, I had alluded to this earlier in the life extension beyond 60 years. It's entitled "Extended *In Situ* in Real Time Inspection and Monitoring Capabilities." A shorter title could have been "Advanced Sensors," but, you know, the title arose as we were trying to be encompassing because this is a very broad area.

This is one of those areas where we got and we were getting staff input. We actually received a lot of staff input from the very disparate technical areas that were all coming back and saying, "We need better sensors. We need more advanced sensors." And we tried to incorporate a lot of the ideas that we were getting from these very disparate areas into one

area that looked at sensors as a whole.

So the objectives behind this research are twofold. One, we want to expand the current monitoring capabilities that we have. And the specific example is we want to improve the evaluation of critical systems, both during normal conditions and then, more importantly, accident conditions.

For sensors, at least commercially as an area over the last 10 to 15 years, there has been quite a renaissance. And we have seen a lot of applications, not in the nuclear sector so much but certainly many other commercial and industrial settings. And we think some of those same types of sensors may be appropriate in nuclear environments.

Also DOE's NERI, one of the programs they have, they have an industrial technology program on sensors and automation. So this is work that DOE has been working on for some time.

And we're certainly looking at using the things that they are doing to try to piggyback and determine if any of their work might have nuclear applications. And NERI is specifically looking at advanced sensor technologies, improved information processing, next generation control and automation, including robotics.

MEMBER WALLIS: It's very good for aging. I mean, this idea that you inspect things every five or ten years or something, you only inspect some of them. It would be so much better to have something monitoring the plant all the time. And when something unusual begins to happen, you get some indication.

MR. TREGONING: You get two things. You get a determination of what the baseline state is. And then you get a real-time delta when that baseline starts changing. In many cases, that can be a more -- even if you don't know what's happening, just knowing that something is happening.

MEMBER WALLIS: Even automobiles are going to this kind of thing. Where your engine begins to sort of shake a little bit more or something, it's time to do something about it.

CHAIRMAN POWERS: It seems to me that the DOE invested substantially in what are called advanced diagnostics where it was looking, I think, to go to just-in-time maintenance. That is, you would equip a pump with enough sensors that you could tell it needs to go to maintenance.

And they never seem to go anywhere. I mean, the people doing it set up pumps with lots of detectors on them and got lots of baseline signals and

whatnot.

I think the test pumps didn't fail on them. So they could never say, "Ah. We should have done the maintenance two weeks ago" or something like that.

But be that as it may, it never seemed to go anywhere. And I once was entreated at an ANS meeting by someone who was in the business of running a nuclear power plant. And his response to having real-time monitors and various things was "I have to file a ton of paperwork every time my inspector finds something. Do I really want something that's finding things ten times a second?" He says, you know, "I don't think I want that. That does not seem to be progress to me."

MEMBER CORRADINI: Or if I could go further with your car thing, my oxygen sensor light comes on all the time. And it says, "Check engine." And I go, and my auto dealer says, "Oh, ignore that one. That's not a useful one. Move on."

CHAIRMAN POWERS: And the difference would be you would have to file an LER with the NRC --

MEMBER CORRADINI: Right.

CHAIRMAN POWERS: -- and have an augmented inspection team come look at your automobile. I mean,

these seem to be challenges that the agency faces in this area.

Again, you know, my reaction, every time I see a crack in something reported here is how pathetic our ability to detect and size cracks and things is. I mean, it is just awful compared to what we would like to have. And so it seems to me it is worthwhile to go find something better.

You know, we can always find a crack, but we can't tell how deep it is or we can tell how deep it is, but we don't know whether it will grow. I mean, it's always something that we can't do on a crack.

MR. TREGONING: You raise a number of very good points. I don't want to oversell this in the sense that sensor development has been going on for 30 years or more. It's something that you mentioned.

You know, I'm familiar. DOD as well is having a large effort in this area in terms of advanced condition monitoring. And it also has received numerous fits and starts.

We don't envision something maybe that grand and that all-encompassing at this point in time. And we do realize that, look, quite frankly, there is going to be resistance from nuclear plants to

implementing a lot of this new technology

CHAIRMAN POWERS: Especially if they are required to do it.

MR. TREGONING: Right. So we understand that. So I think, at least early on, we are going to be looking at things that are more modest. And evaluating reliability and accuracy of these things is going to be important, right? Because we don't want to have things where we are generating a lot of false positives or positives that at the end of the day don't have much impact on risk.

MEMBER CORRADINI: But if you reverse this, what has the industry already incorporated in the non-regulatory framework in their plants to keep to improve their reliability? Have you asked?

I mean, if I take you into a secondary system, I would assume that, for example -- I don't know if you have ever toured a modern day natural gas combined cycler plant. It takes 2 people to run a 150-megawatt plant. That's it, two people on site, ten PCs.

And have you looked at other technologies and what they use to improve reliability?

CHAIRMAN POWERS: And ten guards.

MEMBER CORRADINI: For the natural gas

plant? I'm sorry. No. For the natural gas plant, there's no problem.

But I guess what I'm thinking of is if you looked at other power plants that are trying to strive for reliability, what do they use in terms of monitoring and inspection that doesn't involve regulatory but actually drives them to improve reliability? And what could you learn from that approach? Do you see what I'm thinking of?

MR. TREGONING: Yes, I know. And that's an excellent point. And that's something that, again, I can't address intelligently now, but I do think that as we continue to do scoping and evaluation of what is the best path forward here, that is fertile ground to hoe in my mind because, again, since they're not required to do that from a regulatory --

MEMBER CORRADINI: They are doing it because it saves them money.

MR. TREGONING: They are doing it from an economic perspective. And that's potentially a way that some of these things may become more viable.

This is one that we have to be careful because, again, Dr. Sheron mentioned that we just don't go off and do research. So this is one where the industry's heading is incredibly important.

MEMBER ARMIJO: Look, I will give you an example of things that concern me. You know, in material degradation, the BWRs have implemented hydrogen and noble metal treatment. And if you look at a lot of the experimental work, the crack growth can be stopped completely or at least slowed down by a factor of ten or more.

But how good is that? And what transient in the water chemistry could start all over again? What is the long-term reliability of that new water chemistry? And is that something that would fit into this category? We're relying that that is going to keep materials from cracking in BWRs to a great extent. And the PWR guys are now thinking about adding zinc and slowing down PWSCC with that process.

What in your program is dealing with how much confidence you can have in those water chemistry, advanced water chemistry, processes?

MR. TREGONING: Again, this is an area that I will quickly run out of my knowledge, but water chemistry --

MEMBER ARMIJO: The standard, the base program, let's say the $70 million program that the Commission has already got and not in this advanced or long-term --

MR. TREGONING: Water chemistry management is an issue that the plants have to deal with now. And, again, I think Dr. Shack may want to jump in here. It's one that, at least globally, the plants have to assure and manage appropriately. So, however, if there are sensors -- and I don't specifically list those, but if there are sensors that could do more real-time monitoring than periodic water sample inspection --

MEMBER ARMIJO: They have the ECP sensors.

MR. TREGONING: Right.

MEMBER ARMIJO: And they even have crack growth sensors for experiments but not for routine application.

MR. TREGONING: Right. Now, again, there are two aspects to the example you made. There is the water chemistry, how much is the water chemistry varying over time, but then there is the effect. What is the effect on the structure; i.e., are the cracks growing?

MEMBER ARMIJO: Right.

MR. TREGONING: And both of those are potential applicants for something like this. I mean, we specifically talk about here in the uses on this slide monitoring real-time material degradation,

characterizing residual stress.

Again, I don't want to oversell this because in some ways this has been the Holy Grail for the last 30 years, at least in the material areas. So, you know, when we look at this program, we want to provide an objective look as to what is really out there and what do we think we could buy ourselves, not only as an agency but potentially to sell it to the industry as well, what are the advantages from their perspective.

MEMBER SHACK: But a lot of this is economic.

MR. TREGONING: Yes.

MEMBER SHACK: I mean, you know, from a safety requirement, you require now what you think is enough to ensure safety. Now, whether they could do it more cheaply and whether you would require them to do these capabilities, you know, it would seem to me a great deal -- you know, this seems more like an industry problem than your problem.

MR. TREGONING: Well, again, one of the aspects of this will be pulsing industry to see where they go. So, again, this is not an area that we are going to have the lead on.

MEMBER ARMIJO: Did you have anything

specific on characterization of fuel properties?

MR. TREGONING: Fuel properties in terms of, you know, the amount of burn-up, the amount of oxide formation, things like that, the current state of the fuel, as much as possible.

And then I did have some specific items for severe accident conditions. We talked about there is an area where we got a number of ideas from staff monitoring things like core temperatures up to core failure and relocation, so much higher temperatures than we typically have any indication of; PWR vessel levels; steam generator vessel levels during a LOCA; and even some ideas of injecting miniaturized sensors after the accident initiates the monitor conditions.

PARTICIPANT: Fantastic voyage.

CHAIRMAN POWERS: Well, following TMI, we put in requirements to monitor fission products in the system. And now we are taking them out because the information is too late for the decision-making process. Why do we want to replicate that failure?

MR. HELTON: This could be even going into the area of responding to an event after it has happened. If you had remote sensors that allowed you to tell steam generator vessel or steam generator level if you had sensors that would allow you to

characterize the state of the system, then they might help guide you in terms of your response to the accident. So there is certainly the information-gathering standpoint.

CHAIRMAN POWERS: I will come to the Brian Sheron rule. Is there anything I am going to do besides put water on the core?

MR. HELTON: You might put water on the steam generator tubes.

PARTICIPANT: All of the time.

CHAIRMAN POWERS: If I have got water, I am going to put it on the core.

MR. TREGONING: Charlie, do you want to?

MR. TINKLER: Well, Charlie Tinkler from Office of Research.

Some of this has to do with sensors and instrumentation that might or could be available for risk-dominant sequences for which current instrumentation is not available.

As an example, decking water into the vessel is always a good thing, but if you have lost all your normal-level instrumentation, all your regulation-required instrumentational level, and you overfill to the steam lines in a BWR, then you have lost the turbine-driven system that provided that

water.

So with some supplemental or new or different kinds of instrumentation that would expand your coverage in terms of monitoring conditions, you could make existing equipment much more efficient in responding to risk-dominant sequences.

I can't talk about the particulars with any more specificity because it has applications for security events, but there are cases where with a little more instrumentation, you could have gone to a condition of long-term stability. It's the lack of instrumentation in an SBO-type of sequence that prevented you, even though you had turbine-driven systems. That's an example.

MR. TREGONING: So in '09, what we're talking about here, again, working in concert with the industry is understanding or selecting a few promising sensor candidates that, again, NRC and the industry have mutual interest in evaluating that consists of the regulatory and technical considerations so that we can verify all of the things that we have talked about, reliability, accuracy, and acceptability for nuclear service, and then, again, develop as need be research plans so that we could obtain regulatory use and approval for any of those candidates that are

identified.

MEMBER ARMIJO: What if the industry guys told you, "We're happy with the sensors we've got. We don't need anything new"? I hope they don't tell you that, but --

CHAIRMAN POWERS: They will. They will. They will tell you that exactly.

MEMBER ARMIJO: I can still hope. I can still hope. But what would NRC do with this plan? They will say, "Well, we will wait until you guys grow up or" --

MR. TREGONING: Well, again, this is an area where we can't move forward without industry having some end use in mind, some planned application.

So if industry truly said that and there were no way to convince industry that, "Hey, look at these suites of sensors. We think these do have benefits," then, yes, without speculating too much further, I think it would be difficult to proceed in light of that eventuality.

MR. SIU: That being said -- and this has come up in an entirely different context -- we have been reminded that we need to stay up with the state of the art in different areas.

If we have the notion that there is a

possibility we might see an application coming down the road, it sometimes takes some time to build up the ability to review and approve a particular application. So there may be some low-level effort, I'm not saying necessarily in this area, but in other areas.

MR. TREGONING: Yes. That's a good point. Excellent.

Any other questions on this before we move on?

CHAIRMAN POWERS: I think I will interrupt you at this point and take a 15-minute break. So we'll reassemble at 3:15.

(Whereupon, the foregoing matter went off the record at 2:57 p.m. and went back on the record at 3:16 p.m.)

CHAIRMAN POWERS: Let's continue on.

MR. HELTON: All right. The next area we are going to talk about is off-site mitigation strategies, capture and clean-up of radioactive materials following a postulated severe accident that has led to a fission product release from containment that has migrated off site. Other entities are looking at the scavenging agents for other purposes.

And the idea here would be for us to stay

abreast of their activities such that we would be aware of what technologies are out there, what their efficacy is, what their potential applications are such that if the agency decided or another federal agency decided to go down that path, we would be cognizant of the work that has been going on.

CHAIRMAN POWERS: A bit elliptical.

PARTICIPANT: I think it's intended to be.

CHAIRMAN POWERS: Other entities?

MR. HELTON: There are commercial and national laboratories, commercial entities and national laboratories entities, that anecdotally we know are doing work for the government or for others looking at capture and cleanup of agents that might be disbursed.

CHAIRMAN POWERS: There is an aggressive activity and has been for some time in the area of responding to dirty bombs. At one point I was told that there were 26 divisions at Sandia working at some aspect of cleaning up after dirty bombs. I have yet to see much of that come to fruition. Is that what you're talking about?

MR. HELTON: Sandia is one of the entities. A colleague of yours, Dr. John Brockman, does work at his aerosol lab that deals with capture

efficiency. We have anecdotal evidence that there are others. We may learn more during phase two.

CHAIRMAN POWERS: There are a couple of DARPA activities in this area.

MEMBER WALLIS: Artificial thunderstorms or something. It's a pretty big thing to really catch this stuff that is floating around.

MR. HELTON: Yes, yes. Certainly the quicker you get it, like most things, before it's disbursed, that's a good thing. But yes, there is evidence that the people are looking at this on a large scale.

CHAIRMAN POWERS: Yes. Everything is super idiomatic. So everything goes up.

MEMBER WALLIS: Heat it up and gone.

MR. HELTON: I have not heard anybody attempting to do weather control to do this.

(Laughter.)

MR. HELTON: We are not going quite that far afield.

CHAIRMAN POWERS: But your intention is just to stay aware of what is going on?

MR. HELTON: Yes and to understand whether or not it has potentials for useful application in this --

CHAIRMAN POWERS: I mean, I had certainly heard of people proposing things like, well, follow-ons to the sort of things that had gone on at the Chernobyl accident moving in external spray systems, Graham's artificial thunderstorm, some sort, things like that. But that is not your intention. Your intention is really to pay attention to what is going on in other forums.

MR. HELTON: I think the spray system is certainly one of the ones that is out there that we are interested in. It's not our intent to develop that per se with this activity.

PARTICIPANT: Okay. Thank you.

MR. NICHOLSON: Tom Nicholson, Office of Research.

This morning, we, Jake Phillip and I, attended -- there's a federal remediation technology roundtable that the EPA's Office of Innovative Research conducts. And the military is there, the Navy, the Air Force, the Army, EPA, USGS. Department of Energy is quite active.

There has been quite a bit of work done over the last couple of years with regard to remediation and mitigative strategies with regard to soil and groundwater contamination. And we have been

following that work.

We have been able because of following the work to find out an awful lot about very site-specific types of remediation that may be possible given a release off-site, even on-site contaminant plumes. And so, therefore, because of that, we have done some work now with Pacific Northwest National Laboratory. They have been doing a lot of studies on *in situ* via remediation of uranium and other radionuclides. So we are aware of what is going on in the federal community.

CHAIRMAN POWERS: Are you saying that this research is actually already underway?

MR. NICHOLSON: Our knowledge is underway. The only thing we have been funding in PNNL was basically to have them identify performance indicators to be monitored to confirm the effectiveness of one type of remediation called institute bioremediation. But we have not been actively involved from the standpoint of actually sitting down and doing field studies with DOE and others to think of what kinds.

One thing we have learned so far about mitigative techniques and remediation is it is highly site-specific, source-dependent. The heterogeneities of both the soil and the unsaturated and saturated

zone are extremely important.

Some people, unfortunately, choose remediation strategies and mitigation before they understand the site. And that can be quite disastrous. At one nuclear power plant in which they have had some releases from spent fuel pools, they went out and put in what's called a capture well to try to create a cone of depression.

In doing the pump test for that, they caused contaminants to move from another spent fuel pool. And so they got cross-contamination. So now obviously they are abandoning that approach. But we had counseled them "Think before you do" because groundwater is quite complicated, especially in certain media like fractured media.

So it's something that we really probably should be thinking about if there are abnormal and severe accident conditions that require somebody to think about mitigation. Monitoring is the key and as close into the source as possible.

Thank you.

MEMBER WALLIS: There's a wonderful phrase in your document which says, "With containment failure, the potential consequences of a radioactive release are not trivial." I wonder who wrote that.

PARTICIPANT: That's accurate.

MR. TREGONING: If there are no other questions on mitigation strategies, I will move on to the next topic that we touched on a little bit, at least by example, earlier on when Dr. Sheron was here. And that was the item on nanotechnology for nuclear power applications.

This is another broad one. It has got aspects potentially related to sensor development. There are also aspects. Tom Nicholson just mentioned containment cleanup. There are specific examples where nanotechnology has been at least demonstrated under laboratory conditions for those applications. And this is an area where at least up until now we have tried to maintain at least a modicum of expertise in terms of evaluating at least what is out there.

So the objectives for this '09 effort are to identify once again candidate nuclear applications of nanotechnology and develop plans that would support their regulatory use.

Currently we are one of the partners in the National Nanotechnology Initiative, or NNI. That is an effort that is headed by the National Science and Technology Council, NSTC, which is a cabinet-level position. And it currently includes about 25 federal

agencies. And we are one of those agencies.

Now, of those 25, there are only I think maybe 9 or 10 who are actively funding research in nanotechnologies. The NRC is not one of those ten funding agencies.

And if you look at who is funding, it's a handful of agencies that is driving the work. And it is the usual suspects: DOE, DOD, NASA. EPA is up there.

CHAIRMAN POWERS: I had occasion last year to look at the Web sites for every one of the national laboratories. And aside from the fact that every one of the national laboratories claims that they provide innovative system solutions to our customers' problems, they also all indicated that they were experts in the area of nanotechnology.

MEMBER ARMIJO: As are all universities.

CHAIRMAN POWERS: I will grant you that, too. But they don't provide innovative system solutions to --

MR. TREGONING: You have to realize the buzz word aspects associated with nanotechnology. It's also interesting if you go on the DOE Web site and count the centers of excellence in nanotechnology, it's virtually every accredited university.

MEMBER WALLIS: Presumably this is a small job. This is a part-time job for one person to keep track of stuff and then if anything develops, to make something of it, if necessary.

MR. TREGONING: Essentially, yes. This is along the --

MEMBER WALLIS: It's called a major thing.

MR. TREGONING: This is a small thing. And so we're doing this to some extent now. And, really, what we're proposing here is to continue that tracking and look at ways for possibly -- if more than tracking is warranted to justify why is that so and then develop the plans that would be needed to have that come to fruition.

So, again, for those who aren't familiar, NNI, a principal objective is trying to identify and foster the quick commercial transition of scientific discoveries in the commercial applications of nanotechnology.

Here are some uses that we talk about, but, you know, they really span the globe of a variety of areas that are potential uses of nanotechnologies. And, again, as Professor Wallis indicated, in '09 we are planning --

MEMBER WALLIS: One very useful

nanotechnology is boron dust as a leak detector.

CHAIRMAN POWERS: It's boric acid dust, not boron dust. Boron dust is not --

MEMBER WALLIS: Where does the boron come from? Okay. Boron.

CHAIRMAN POWERS: What will explain to you thermal hydraulicists the effects of oxidation around the properties of materials.

MR. TREGONING: Who knows? Maybe we will develop some advanced sniffers to indicate when we have got boron dust particles floating around containment. So in '09, we are proposing to continue participation in the NNI.

Again, working with industry, this is similar to the others: Identify viable applications and then develop plans as appropriate.

MEMBER CORRADINI: So I will give you one suggestion here.

MR. TREGONING: Okay.

MEMBER CORRADINI: I would really suggest you work backwards. Start looking at other industries that have actually gotten something useful out of this.

CHAIRMAN POWERS: The two or three?

(Laughter.)

MEMBER CORRADINI: Well, actually, I have one example. I only have one example. It's in my pocket. I can't find it. There it is. Something small is that. I haven't identified much, but that is one.

MR. TREGONING: There are at least a handful of commercial --

MEMBER CORRADINI: I'm sure. But seriously I do think that if there are parts of products that can be brought in to improve, obviously, but if it's just so that you guys can use the four-letter word like everybody else can use a four-letter word, I would suggest you look at where else it has been used successfully.

MR. TREGONING: Steve might want to elaborate on this. I think that is one of the powers of NNI, the fact that you do have a consortium that is already in place that is examining exactly those questions. I think monitoring those developments will keep us abreast of understanding those applications which had been successful.

MEMBER CORRADINI: I mean, just so you can see where I am going with this, for example, I would go to specific industries that make money off of this, like 3M. And I would find out where 3M actually has

engaged in this that actually improves their products or I could pick others.

But primarily companies essentially use it in the fundamentals of material science, and that improves the product. And then that might lead you to saying, "Aha. Maybe this."

But that is how I would do it. I would work backwards from where people make a lot of money off of it. Then you actually see a real buy-in.

CHAIRMAN POWERS: Rob, in this general area but not the specific subject, I see a lot of talk about ion implantation for surface hardening of materials and changing properties of surfaces and materials and things like that.

Should there be a corresponding -- or maybe there already is a corresponding activity by NRC on that because that really does work.

MEMBER CORRADINI: I was going to say there are facilities. I know the fellow at Sandia who works with one of my colleagues that does exactly this --

CHAIRMAN POWERS: Oh, there are huge industries in ion implanting, nitrogen especially, and nitriting surfaces make them hard without damaging the fracture toughness of underlying materials.

MEMBER CORRADINI: At the monolayer.

MR. TREGONING: Yes. And those are all good applications. And certainly material manipulations in terms of surface modifications and things like that, there has been a lot of prominent research in that area. So that is something that I don't specifically call that out here, but, again, those are relevant areas to look at for monitoring.

MEMBER SHACK: Does anybody from Research go to MRS meetings?

MEMBER CORRADINI: Yes. There you go.

MEMBER SHACK: Send one guy.

CHAIRMAN POWERS: And they're excellent, by the way. And you can't send one guy.

MEMBER CORRADINI: They're a really excellent meeting.

CHAIRMAN POWERS: There are huge numbers of parallel sessions going on.

PARTICIPANT: Thousands.

PARTICIPANT: A big budget.

CHAIRMAN POWERS: But, I mean, it is probably going to pick a society other than the American Nuclear Society, which is top parallel.

MEMBER CORRADINI: In terms of usefulness?

CHAIRMAN POWERS: In terms of usefulness.

MEMBER CORRADINI: I mean, just I don't want to do this to my colleagues, but you have a lot of contractors that get money from you. And a lot of the new material science, you can go to MRS. It wouldn't hurt to actually ask them when you are at MRS as one of your deliverables "What did you see there that could be useful back to the agency relative to applications?" I mean, I'm thinking of a lot of folks from --

CHAIRMAN POWERS: I mean, they are required to write a trip report. And usually people struggle with "What am I supposed to write about?" This at least gives them some specificity.

PARTICIPANT: If they found out what we were going to, they might not get to go next year.

MR. TREGONING: Okay. Those are great suggestions. Thanks. I made notes of that.

CHAIRMAN POWERS: Press on, sir.

MR. SIU: Okay. This is me, Nathan Siu, Office of Research.

This topic is effects of fire on fiber optic cables. We're aware that fiber optic cables are going to be used on new reactor designs. And, in fact, I've been told that maybe some current plants have had some installations.

The Committee is well-aware that we have done a lot of work on fire and done some recent work on the effects of fire on conventional cables in a program called CAROLFIRE, which I believe we're going to be briefing you on sometime in the near future.

Naturally we have the same kinds of questions that come up when you bring in a new technology like fiber optics. What is the fragility of the cable with respect to fire effects? And does the cable act as a combustible source of fuel for fire propagation?

And you might say, "Well, fiber optics, what's there?" Well, they're jacketed. Like anything else, they have PVC. They have outer coating.

CHAIRMAN POWERS: They even have thermal plastic coating.

MR. SIU: Yes, right, right. Now, melting of thermal plastic might not be such a bad thing for this versus, let's say, a copper conductor. I don't know. These are things we don't know.

So we would, of course, be interested in assessing the fragility and combustibility, at least for the purposes of fire risk assessment and possibly even from a more deterministic standpoint. Obviously --

MEMBER WALLIS: I wonder why you picked this out. I mean, fire is going to be a research topic for quite a long time because there are all kinds of unresolved questions. The question just hasn't been resolved very well.

MR. SIU: Yes. Again --

MEMBER WALLIS: Why did you pick out this particular one?

MR. SIU: This gets back to the issue of what is in our regular fire research program versus the long-term aspect. Now, this one --

MEMBER WALLIS: Why isn't this in the regular fire research?

MR. SIU: It actually is things developed. It might turn out it will end up there. You know, there is a phasing here as we went through our process. We said, "Well, what is the new technology coming down for new reactors?" Fiber optics.

And then this wasn't necessarily just our idea. We talked to folks in NRO about this. We put it in the plan. And as people thought about the plan, we said, "Well, maybe it belongs somewhere else."

Along the lines of your point and much earlier, it's a good topic to look at. We put it in. It's a planning wedge. At some point later, it might

find its way into another plan. And that is okay.

CHAIRMAN POWERS: But that should be the evolution of any of these.

MR. SIU: That's right. And that's a valid point. That's right.

CHAIRMAN POWERS: Actually, it is a pretty good example. You don't have a lot of fiber optics in your safety systems now, but, I mean, there is a non-zero probability you will in the future.

So it is appropriate according to your definitions for the longer-term circuit. But you can well anticipate that it could in the next five years move into the actual fiber circuit program. So it's not a bad example.

MR. SIU: And there are requirements in NFPA 804, which is the fire protection program for advanced reactors, which talked to protecting against, for example, spurious actuation.

Well, again, we don't have much knowledge about how these would behave under those conditions. Perhaps other industries and I would imagine other industries have a lot of experience already with fires in same telephone exchanges.

So the literature source is, of course, the first thing we would do and, if necessary, develop

a model, maybe even identify experiments that we have to perform to quantify parameters in the model.

Okay? Next one, please. This one is a general topic, although our fiscal year '09 activities are fairly limited. The broad notion is to improve our empirical database for PRA models when we are talking about new facilities. And by empirical data, now sometimes in PRA-speak, we talk about estimates for failure rates as data. Well, they are data for the models, but they are not the empirical data we're talking about.

We're talking here about actual failures or degradations of components in the case, let's say, of a check valve for a passive system or the, again, human performance with the advanced human-machine interface associated with advanced reactors, possibly entirely different modes of operation for advanced chemical facilities, like fuel cycle facilities.

So the notion here is to start exploring ways that we can supplement our database. Of course, by its nature, the failure of data tend to be sparse. In many cases, they may be of limited relevance to the new systems. And, of course, the conceptual design would be nonexistent.

MEMBER WALLIS: Yes. These are questions

you are asking today, aren't they? Why is this long-term research? The passive system PRA is work that is going on now.

MR. SIU: Yes.

MEMBER WALLIS: HRA carry is going on now.

MR. SIU: Right. Now, again, the long-term aspect of this has to do with the application to systems. I mean, clearly there could be some benefit to the current systems, current problems. But the focus would be to look at issues that are associated with the advanced facility; for example, the advanced human-machine interface. That's the sort of thing we could go to other industries that have adopted such systems, let's say the offshore oil industry, which also does PRAs, and try to learn from them, see what data they have.

Now, it is exploratory. There are questions about whether the data would be of sufficient quality, applicability, and even whether they are available to us to use.

CHAIRMAN POWERS: Nathan, you could call this the acronym AEOD and I one day grow up and go into an entire office in the NRC.

MR. SIU: Yes.

(Laughter.)

MR. SIU: Yes, right. Thank you. Thank you. Well, yes. And where this gets a little different, again -- and we constructed this with knowledge of other programs.

I will give you another program that is going on right now in CSNI. It's starting up an activity looking at collecting simulator data for HRA. That's plant simulators and using those in an HRA context.

So it's beyond Halden. We tried to avoid that by saying, "Okay. What's another source of information that would be potentially useful." This is where we are going to the non-nuclear sources of information. So we are trying to carve out a piece here that would help the data problem.

In fiscal year '09 again, it would be focusing on human reliability. This is one of the things that our program offices asked us to really emphasize, was to try to extract qualitative information about events that occur, not just focus on quantification of the human error probability.

So we would make sure that we try to understand the failure mechanisms along the lines of using the structures, again, for our current HRA models.

And then as maybe the data are good enough or not to support quantitative risk assessment. That would have to be the result of an evaluation.

The next one is related only because, again, the fiscal year '09 for data focused on HRA, but that topic is broader. This particular topic is indeed aimed at HRA.

Again, the long-term aspect, both the fact that it's aimed at advanced facilities and, as Dr. Powers pointed out, this work can take a long time to do to make advances in this area --

MEMBER WALLIS: Before you extend current HRA capabilities, maybe you need to sort out the current ones.

MR. SIU: That's work that's ongoing right now. And you get reported on periodically.

CHAIRMAN POWERS: I don't understand the distinction between this and the one on digital I&C and human-machine interface. The human reliability we worry about here is one where the human is interfacing with a machine. I mean, how is this distinct or is this just a subset of that?

MR. SIU: This would benefit from that facility that you heard described. For example, I believe you were briefed on the benchmark study for

Halden.

CHAIRMAN POWERS: Yes.

MR. SIU: So that is a case where it is an open question, how to design a simulator study to support improved quantification HRA models. That's a step. Maybe we get that technology in hand so by the time this neat facility is put together, we know what to do with it from an HRA perspective, quantification perspective. So I see that as the relationship between the two.

MEMBER CORRADINI: And this fits into that?

MR. SIU: This is the idea of simply how do you do human reliability analysis for an advanced facility? Now, when you get to what is the data you use to perform that assessment or how do you know that your models of performance are correct, you need empirical data and empirical data in this case a controllable source where you can vary the conditions, test hypotheses, and come to the conclusion that this particular context for operator performance is the most challenging one or this is how you should be characterizing stress in a way that can be operationalized in a human reliability analysis. There are lots of issues that you can address using a

simulator, whether it's in the U.S. or in Halden.

MEMBER CORRADINI: Right, right. But I guess I am still struggling. I read this. I guess Dana beat me to the question.

MR. SIU: Okay.

MEMBER CORRADINI: I thought this was a subset of the previous one. This is not. This is the context for all sorts of facilities, reactors, fuel reprocessing facilities, fuel fab facilities. Is that the point of this? That's what I'm still -- I don't understand the context of this relative to the past stuff.

MR. SIU: Okay. Just to be clear, the past stuff was the --

MEMBER CORRADINI: That was a facility.

MR. SIU: Facility?

MEMBER CORRADINI: That was a facility.

MR. SIU: Okay.

MEMBER CORRADINI: Is this the broader context of given all sites of things that are not just reactors, --

MR. SIU: Yes.

MEMBER CORRADINI: -- how do I develop the database?

MR. SIU: No, no, no. This is how you do

the HRA. what methods do you use, what models do you use to employ the methods?

CHAIRMAN POWERS: I thought you had a universal answer for that.

MEMBER CORRADINI: I thought the model would be --

CHAIRMAN POWERS: I thought ATHEANA did everything.

MR. SIU: Okay. Maybe we should have gone through my slides in order. In the background, yes, we believe the current frameworks are general. The current frameworks for doing HRA talk about the importance of context and how context influences performance. Okay. That's a nice general statement. And I don't think there is any disagreement about that.

Once you start operationalizing that to a maintenance action versus a control room action versus -- I don't know -- a glove box -- I don't know very much, honestly, about fuel cycle facilities, but you can see how the particulars -- you know, what is the particular context? What are the particular rules that the operators are following? What are the importance performance-shaping factors? These things I can certainly envision as changing from situation to

situation.

CHAIRMAN POWERS: But what you are talking about are the specifics of application. How can it possibly do this when there are no advanced facilities to do it on?

MEMBER CORRADINI: Right. That's why I interpreted it as that if you had an aqueous fuel reprocessing facility like the MOx that they're building or they were going to have a pyro processing or they turned back on the pyro processing on the old Argonne West and you start trying to decide how people would screw it up when they operate it or then you --

CHAIRMAN POWERS: Argonne West. There's no screwing up by those guys.

MEMBER CORRADINI: That's what I thought.

CHAIRMAN POWERS: Oh, I see. Degradation.

MEMBER CORRADINI: Or, in other words, you move to Idaho. Now it's screwed up. I thought that's what you said.

MR. SIU: In the same way that we talk about general models -- again, let's take maintenance, general models for performing HRA for maintenance for lightwater reactors. And we don't say that you need a different model forth is this plant versus that plant. But the general category of maintenance is

sort of the general kind of activities are performed.

My hope -- this may be unfounded -- would be that the advanced facilities -- obviously we would have to pick something. It's not totally abstract. You can characterize them at a sufficient level to say these are the kinds of activities that will be performed based on reasonable extrapolations or reasonable knowledge of what the design is going to look like but not down to what is the exact procedure.

MEMBER CORRADINI: Okay. I see.

MR. SIU: This is methods.

MEMBER CORRADINI: I understand.

MR. SIU: This is not the model.

MEMBER CORRADINI: So, then, just a thought. Given that these are chemical, at least the fuel reprocessing facility looks a whole lot like any sort of cascade process in chemical engineering, I would assume that there are industries like Dow or DuPont that you could go and see how they do their reliability or their human failure analysis on their facility.

MR. SIU: Absolutely. Absolutely. We are also familiar enough with the chemical process industry that in many cases, we know that they have not tried to be quantitative in their approach.

MEMBER CORRADINI: Really?

MR. SIU: They like the HASOP approach.

MEMBER CORRADINI: Which is all qualitative?

MR. SIU: Yes. What if this happens? What if that happens? And possibly because maybe they don't have quite so many barriers in terms of defense-in-depth. An upset happens, and it's without some action.

CHAIRMAN POWERS: So the more reliance on the operational staff you had.

MR. SIU: Yes.

CHAIRMAN POWERS: And a general approach tends to be more societal than it does individual. The society of what person --

MR. SIU: Oh, the culture. I didn't know what you meant.

CHAIRMAN POWERS: Yes. So it surprised me, but I still am not going to sit here and say, "This looks like an application to send." I don't know how you apply until you have got a facility."

MR. SIU: Well, yes. Again, it may be an unreasonable expectation to say that we can characterize the activities to such a level that we can then do the identification of issues. Again, we

go through these exercises right now. And we do the PIRTs for human factors issues associated with advanced

We're talking fairly general terms, but we know about navigation through screens. We know about the different interface devices that people have to work with. So without talking exactly the design, we know the general characteristics that you have to deal with.

Now, the question from an HRA perspective would be, do we have a way to address navigation through screens? Does it matter? Is that going to affect the outcome at the human failure event level, which is a fairly high course level of modeling in the PRA?

So I think there are questions that we would be addressing. I am not saying at this point that we even assume that we are going to need new methods. It's again identifying what are the issues and can current methods address this.

CHAIRMAN POWERS: It has always seemed to me that the issue that you have with these advanced facilities is there is nothing really for the operator to do, protracted periods, which is just looking at a screen. And they're set up in many cases to react

passively in the event of an event.

MR. SIU: Right.

CHAIRMAN POWERS: And the issue then becomes one strictly of errors of commission.

MR. SIU: Let me give you a slightly different twist on that. Some years ago we looked at a PRA for a plant that the human factors specification for the plant was that the crew was going to look at what was going on, develop a good understanding of what was happening, and react to that.

The PRA HRA that was done for it was a very conventional THERP analysis, which is basically they followed a procedure, boom, boom, boom, boom, boom, here is the answer. It seemed that there was a mismatch between the approach taken or the viewpoints of the two groups.

If one is to say, "Well, I am truly in a mode of sit back and think about what is going on," I would ask whether the implementation of even our ATHEANA approach and how I would do that, what would I need to do to make sure that I am comfortable with that," again, clearly our implementation to this point has been largely on procedure-oriented responses. So I think there are differences in the approach or there could be.

Okay. This one is related to the one that Don talked about earlier. This talks about quantitative risk assessment methods. And, again, it's a recognition that work is going on outside NRC. The answers are being made. The Committee raised the issue or the question of binary decision diagrams and whether we should be using those more in our PRAs.

There are other tools that are being developed now: Bayesian belief nets. Don mentioned simulation. That's another tool that's been used in the context of risk assessment.

And so there have been some applications of current systems, but we see that there is some likelihood that they will also be employed for the advanced designs.

So our notion here is to, again, perform a scoping study, assess where we are in terms of these technologies, and really hopefully develop an informed decision as to whether we should be proceeding along any of these fronts.

Certainly we need to stay aware of them because I fully expect to see some of these being employed.

MEMBER WALLIS: Bayesian belief? I thought Bayesians never believed anything.

(Laughter.)

MR. SIU: Everything is belief in Bayesians. Subjective probability.

MEMBER WALLIS: Yes. Probability is a state of knowledge. It's not a belief.

MR. SIU: Okay. Well --

(Laughter.)

MR. SIU: Boy, you have faith.

CHAIRMAN POWERS: They don't believe anything? Bayesians believe everything.

MEMBER WALLIS: It can be sort of revolutionized by new evidence all the time. So it's a pretty rocky belief, isn't it?

CHAIRMAN POWERS: Like much of science.

MR. SIU: If you can't change your belief after you have been given evidence, I guess that's a worse problem. No. Actually, that's been used in at least one application I understand in a safety culture problem. We can see this as well in treatment, for example, of aging systems and how one might start bringing physical models into the PRAs without going to full-out simulation.

CHAIRMAN POWERS: I mean, my feeling is that it is absolutely important for the NRC to continuously look at the structure that it has created

in here.

I mean, you guys have made PRA. Okay? I mean, it's your invention. But there are lots of different ways to skin that cat. And you have got to continuously go look and see if the way that you have done it is the best way or if there are better ways.

And it's a very difficult job because you have a well-developed technique for doing things. And you can say, "Well, this new way doesn't do everything my old way of doing it." Yes. But it hasn't had the benefit of all of that development. So you've got to be a pretty perspicacious person to look and say, "No. That one has promise."

I hope you do lots of that sort of stuff and even to the point of encouraging people to invent new ways of doing things. We talked about that earlier in connection with APEX and stuff like that.

I think that's good because that is your tool. That is your regulatory. I mean, it is secondary only to defense-in-depth now in your regulatory framework that you have set up. So you had better be defining continuously the state of the art in that field because you have tied your whole agency to it.

MR. SIU: Okay. Last one.

CHAIRMAN POWERS: Now --

(Laughter.)

CHAIRMAN POWERS: -- we don't have Professor Apostolakis here to humiliate on this regard.

MR. SIU: I am a poor stand-in.

MEMBER CORRADINI: Are you going to use this chart tomorrow?

CHAIRMAN POWERS: I encourage you not to use this tomorrow, even though we only have an hour and a half.

MR. SIU: This would be one I wouldn't show. This would be one. I have a few others.

Let me explain what we have here. The formal decision-making methods, of course, cover a wide range of tools, techniques. It's not just the multi-attribute utility theory at the back end of this, but it's also the way you structure the problem, the way you identify your alternatives, the way you do trade-offs, which doesn't have to be, again, a fully quantitative approach.

And there are lots of ways of doing it. Books have been written about it, a tremendous amount of work. NRC has done some work in this area.

I think it's fair to say that in some ways

we use these techniques, certainly in terms of when we come up with problems like this research program. We try to start off with a clear specification of what we are trying to do, what are the ways that we would indicate how they are successful.

This kind of thing also happens with development of other research programs and other kinds of decision prompts. And we don't necessarily make it easy for the next go-round to say, "Okay. We will build on what was done before and take it up further." We don't have ways to make the trade-off problem easier.

It seems to me that while formal decision-making in general requires a lot of thought and resources, it's conceivable that there are ways that we can reduce that level of effort and so to make the effort bounce more with the benefit.

So the idea behind this activity would be, again, we're not trying to revamp how we are doing everything in the agency at this point. The premise is that there is benefit to be gained from using these methods, but we wanted to find out what are really the stumbling blocks in all of the things that we might be able to do to reduce the --

MEMBER WALLIS: Is this ever used in the

agency? It seems to me that the biggest decisions are made by managers with no formal analysis whatsoever.

CHAIRMAN POWERS: That's what he's talking about.

MEMBER WALLIS: Is there any precedent for decisions having been made?

MR. SIU: Yes, there is some. There is some. Actually, I was aware of an activity a while ago in the Office of Research that was prioritizing research activities. And it used the analytical hierarchical process. And, again, the word I got afterwards, "Boy, that was a lot of work" and "Gee, should we do that again?"

But to me, once you start putting it in that frame, you say, "Well, maybe that starts making it more technical." You have a lot of information you need to elicit and to process. Are there ways or tools that could be developed that would lower the amount of energy required to encourage the use of it?

But you can't encourage the use of it if you don't have success somewhere. So that's the notion of a pilot. Find a pilot or some area where we are willing to try it out, identify what were the issues, and figure out what should we do once that pilot is finished.

So it's a quite modest activity, but I think it has a value just because I have some belief in the value of the use of formal methods. I mean, just as you described, if we're continually informal in our decision-making methods, we say we will never change that, then that's where we are. But if we're willing to say we might allow the possibility that we could do better in some circumstances or at least make it easier to arrive at the decision, then that would be some value in doing this work.

CHAIRMAN POWERS: You cite on the slide "successfully used in other fields." I mean, it's surprising, other institutions, other places, but fields. That's interesting.

MR. SIU: Well, other institutions, outside NRC. Again, if we don't limit ourselves to saying "formal methods" means the full-blown application of the KINA RIFA approach, some aspects of it, starting with the formal identification of objectives and working your way down, specification problem. You know, there's that -- what do they call it? -- the proact framework.

MEMBER WALLIS: There are some beautiful books written on this stuff. I just wonder if it ever gets used.

MR. SIU: I guess my understanding is that it is, at least to some extent. Now, again, whether all of the formalisms are used I'm not clear on that. Prassad can expand on that. I don't know if you want to expand on that any further.

MR. KADAMBI: My name is Prassad Kadambi. I'm in the Office of Research.

I guess what I would point out is a useful place to begin thinking about some of these techniques is in the area of performance-based regulation, the guidance that the staff developed in that area, in fact, the ACRS suggested that we should be really making sure that we put decision thresholds in such a way that, you know, in a structured approach, it would make sense to measure performance appropriate to the kind of flexibility and the safety impacts.

So all I would say is that the work that the staff has done offers some context in which if we were able for the NRC environment, you know, and for the kinds of issues that we face, if you are better able to use these techniques which are available, that that would be the objective.

MR. SIU: Other questions? I think that was the last one in just the last --

MS. LIU: Okay. Now coming to the last

slide to close out our formal presentation for this afternoon, I just want to read some of the points that we have talked about earlier today, that we have developed the initial version of this long-term research plan for 2009. And the priorities are now being deliberated as part of the F.Y. '09 budget process within the agency.

And any additional revisions to the candidate research topic can be addressed as a part of the reprioritization next year when we look at the '09 and F.Y. '10 budget as part of your input and other stakeholders' input.

And also we discussed a process for how we intend to do the periodic update and, lastly, that a couple of options exist for possibly requiring any reprioritization of the long-term research activities and also funding mechanism.

I just want to leave you with a couple of other observations based on our interaction today. When we got the assignment December last year to develop this per request of Ryan, we were very enthusiastic, even though we realized that we don't have a lot of time to do this. So we are designing the process as we go to make sure that we will be in time to at least put a planning wedge in the F.Y. '09

budget process.

We will be the first one to admit that we can do everything better and we can think through everything in more detail and at the same time we want to make sure that we capitalize on the opportunity to get the long-term research thinking into a budget planning process.

And also, as any of these activities start to evolve into more detail, we scope out what we actually are going to be doing, then they will come off from the long-term research plan and into its own research plan. So that way we will continue to use this vehicle as a way to generate new ideas and before we are looking.

We will be using the lessons learned and all the observations that we have gathered from this initial effort to make sure that in the future update, we will follow a more systematic process. And then we will address all of the issues that have come up during this particular effort.

One thing that I personally have observed is that not only because of the short-term and long-term we have, also there probably is some level of speculation about how serious this agency truly is in terms of investing in forward-looking research.

So the level of success of all the candidate activities that we have identified in this particular iteration while certainly sentencing of the other people who are sitting on the fence line regarding whether they really want to be formally engaged and be more enthusiastic, and as Professor Wallis indicates, to really let the activities start flourishing and open the floodgate.

So we understand that this is an important adventure for the agency. This is certainly one giant step, we feel, that integrating the agency effort in doing forward-looking research.

And we would welcome any input that you have. Thank you.

CHAIRMAN POWERS: Thank you.

III. DISCUSSION

CHAIRMAN POWERS: We have one chore I want to continue on the record. And that is to advise this team, this excellent team, of what they should bring forward to the full Committee.

I have suggested to them that they begin with Christiana's talk, eliminate the process material but outline first their objectives and the criteria they have used for selecting projects, get to the list of projects, and then round out the presentation by

exploring a few. And that would probably be no more than five of the projects they had selected.

That was my suggestion to them. Do members have anything they want to add or disagree with?

MEMBER CORRADINI: That sounds good. I like that. That would make for a nice --

MEMBER WALLIS: I would like to hear someone's perspective, though. Are these suggestions for projects or are these all ones that you would pursue if you got the money?

MS. LIU: These are ones that we have put into our F.Y. '09 budget. At the same time, if there are other topical areas that come into our attention and we have a fixed pot of resources, we can go in and reprioritize. In other words, we can not do certain activities that would --

MEMBER WALLIS: Once you prioritize, some of these may be dropped.

MS. LIU: Correct.

MEMBER WALLIS: Okay.

MS. LIU: Correct.

CHAIRMAN POWERS: Please?

MR. TREGONING: As well, let me comment on that. Some of these we are pursuing in '07 and '08.

So some of these may be dropped as a result of progress in '07 and '08. So this is one of those processes that we're continually revisiting in terms of prioritization.

CHAIRMAN POWERS: And that, too, is a worthwhile point to make, that this is a dynamic process.

MEMBER SHACK: Yes. This notion that they move from one program to the other I think is a point to be made.

CHAIRMAN POWERS: It is. Okay. If there are no other comments, then I will go off the record. And we will discuss what we bring forward to the full Committee. We are now off the record.

(Whereupon, the foregoing matter was concluded at 4:07 p.m.)