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Safety Research Program Subcommittee

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UNITED STATES NUCLEAR REGULATORY COMMISSION'S
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

May 2, 2007

The contents of this transcript of the proceeding of the United States Nuclear Regulatory Commission Advisory Committee on Reactor Safeguards, taken on May 2, 2007, as reported herein, is a record of the discussions recorded at the meeting held on the above date.

This transcript has not been reviewed, corrected and edited and it may contain inaccuracies.

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UNITED STATES OF AMERICA

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

1 NRC STAFF PRESENT:
2 BRIAN SHERON
3 CHRISTIANA LUI
4 NATHAN SIU
5 ROB TREGONING
6 DON HELTON
7 STEVE ARNDT
8 STU RUBIN
9 CHARLIE TINKLER
10 JOCELYN MITCHELL
11 TOM NICHOLSON
12 PRASSAD KADAMBI
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A G E N D A

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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.)

1
2
3 CHAIRMAN POWERS: The meeting will now
4 come to order. This is a meeting of the ACRS
5 Subcommittee on Safety Research Program. I'm Dana
6 Powers, Chairman for this subcommittee meeting.
7 Members in attendance are Said Abdel-Khalik, Sam
8 Armijo, Graham Wallis, Bill Shack. Professor
9 Corradini may join us in the afternoon, if he so
10 deems.

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

18 Dr. Hossein Nourbaksh is the Designated
19 Federal Official for this meeting. The rules for
20 participating in today's meeting have been announced
21 as part of the notice of this meeting previously
22 published in the "Federal Register" on April 17th,
23 2007.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

10 CHAIRMAN POWERS: Right.

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

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

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

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

9 CHAIRMAN POWERS: Yes.

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

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

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

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

3 DR. ARMIJO: I have a general question.

4 MR. SHERON: Yes.

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

13 MR. SHERON: Yes. We identified in the
14 '09 budget, which is where we are in the request
15 process right now, is formulating that; \$5.5 million
16 and I think it was \$8.1 -- is that right, Chris?

17 MS. LUI: Correct.

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

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

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1 MR. SHERON: That's annual.

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

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

7 DR. ARMIJO: Okay. Thanks.

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

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

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

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

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

20 MR. SHERON: Yes.

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

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

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

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

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

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

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

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

15 (Static.)

16 CHAIRMAN POWERS: Proceed, please.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

22 (Static.)

23 MR. TREGONING: Try again.

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

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

3 CHAIRMAN POWERS: It jumps in, yes.

4 COURT REPORTER: Try it now.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

7 MS. LUI: Correct, because we did --

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

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

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

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

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

5 MS. LUI: The latter case.

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

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

11 DR. ARMIJO: That's the next phase.

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

14 DR. ARMIJO: Okay.

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

19 DR. ARMIJO: Okay.

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

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

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

3 MS. LUI: July.

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

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

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

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

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

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

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

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

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

21 DR. ARMIJO: Okay.

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

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1 improving it.

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

8 MR. SHERON: Yes.

9 DR. ARMIJO: And you would revise it.

10 MS. LUI: Yes.

11 MR. SHERON: We could change the
12 priorities.

13 DR. ARMIJO: Yes.

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

17 DR. ARMIJO: Okay.

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

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

3 MS. LUI: By and large, the other program
4 offices were really focusing on more near-term and
5 current regulatory issues. And there were a couple of
6 ideas that's looking at more forward-looking. And I
7 think -- and given that -- I believe that this effort
8 has already resulted in a lot of good collaboration
9 and got people started thinking along that line,
10 because they know that we're serious about doing this,
11 and we want to keep this as a living document. So
12 given that this is an initial effort, I think we are
13 kind of carving out a process, and learning as we go.
14 And at the same time, really start to try to motivate
15 the other program offices in collaborating with us to
16 go towards where we really would like to go, is to
17 really start thinking seriously about where - 5, 10,
18 15 years from now where this agency is going to be.

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

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

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

11 CHAIRMAN POWERS: Have you ever formulated
12 a user need?

13 MS. LUI: Pardon me?

14 CHAIRMAN POWERS: Have you ever formulated
15 a user need?

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

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

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1 faster, that's what I would do.

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

19 CHAIRMAN POWERS: I understand your --

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

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

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

1 CHAIRMAN POWERS: And it loses on the
2 hierarchy plan.

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

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

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

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

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

25 MR. SHERON: Okay.

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

5 MS. LUI: Actually, I may understand what
6 --

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

9 MS. LUI: Yes.

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

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

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

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

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

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

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

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

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

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

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

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

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

15 DR. CORRADINI: Oh.

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

21 CHAIRMAN POWERS: And was.

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

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

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

11 MR. SHERON: With the Inconel 690.

12 DR. CORRADINI: Okay?

13 MR. SHERON: They're off replacing
14 everything, and they're saying Inconel 690 is the
15 greatest thing since canned beer and sliced bread
16 combined. Okay? Tough material. All right? They
17 told us that, and this is even before I was in the
18 industry, they told us that about Inconel 600. All
19 right? And it's cracking away like you wouldn't
20 believe. The question is, where are we going to be
21 20, 30 years from now with Inconel 690? Is there
22 something we don't know about it? So long-term
23 research might be to say, can we do accelerated aging
24 tests, and look at Inconel 690. Does that help?

25 DR. CORRADINI: That's helps.

1 MR. SHERON: Okay.

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

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

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

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

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

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

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

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

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

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

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

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

11 CHAIRMAN POWERS: A topic for another day.

12 MR. TREGONING: Okay.

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

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

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

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

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

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

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

9 MR. SHERON: When was this, Dana?

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

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

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

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

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

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

25 Going into a little bit more detail on

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

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

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

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

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

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

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

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

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

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

13 MR. SHERON: When was this done?

14 CHAIRMAN POWERS: Maybe two years ago.

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

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

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

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

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

4 MR. SHERON: And more.

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

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

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

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

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

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

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

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

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

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

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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.

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

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

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

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

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

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

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

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

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

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

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

23 MS. LUI: I would --

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

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(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

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

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

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

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

1 on.

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

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

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

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

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

16 CHAIRMAN POWERS: Please go ahead.

17 MS. LUI: Okay. So coming back to slide
18 9, usually around the time of October, November, and
19 December, that's when the agency will come out with
20 budget assumptions for -- right now, for example, with
21 FY '07, the budget assumption is for FY '09, so we are
22 always two years ahead of time. And at the same time,
23 the FY '08 budget is being reviewed by Office of
24 Management and Budget, so we're getting feedback on
25 the FY '08 budget, so at any given time that we are

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

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

16 MS. LUI: Correct. Slide number 10 - we
17 come in front of the committee, and the committee
18 continues to provide your recommendation based on your
19 review of the individual research activities, and your
20 review of the program offices' activities, and also,
21 at Commission's request. And we are also aware that
22 every two years, you do publish your report, NUREG
23 1635, to make recommendation and comment on the
24 research program, in particular. So while we believe
25 that in the future, how we can really integrate your

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

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

12 And, of course, that we understand that
13 you will be providing your recommendation to the
14 Commission in March 2008, so that would be very timely
15 for us to incorporate your recommendation into the FY
16 '10 update of this particular research plan.

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

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

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

25 Just to kind of summarize some of the

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

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

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

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

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

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

3 MS. LUI: Yes.

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

8 MS. LUI: Correct.

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

12 MS. LUI: It's being --

13 DR. CORRADINI: This summer.

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

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

21 MS. LUI: Correct.

22 DR. CORRADINI: Okay. Fine.

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

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

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

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

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

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

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

20 MR. SHERON: Right.

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

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

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

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

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

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

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

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

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

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

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

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

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

25 CHAIRMAN POWERS: Ordinarily, ACRS would

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

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

15 CHAIRMAN POWERS: They do have to comment
16 on it.

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

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

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

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

9 MR. SIU: Yes.

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

22 MR. SIU: Thank you.

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

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

5 MS. LUI: Yes.

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

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

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

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

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

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

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

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

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

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

16 MS. LUI: Okay.

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

20 MS. LUI: Thank you.

21 (Whereupon, the proceedings went off the
22 record at 12:01 p.m., and went back on the record at
23 1:00 p.m.)

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

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

4 One deals with the GNEP, the Global
5 Nuclear Energy Partnership. The other one deals with
6 the possibility of renewal of license reactors beyond
7 60 years. The third one deals with test facilities.
8 The final one they call cross-cutting and emergent
9 technologies. That seems to be the one that they have
10 done their first stab at breaking it down into finer
11 categorizations.

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

13 II. CANDIDATE LONG-TERM RESEARCH ACTIVITIES

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

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

25 On the other hand, when we go into a

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

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

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

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

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

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

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1 needs and the technical bases for doing that.

2 NRC is already interacting with DOE on
3 this topic. DOE is in the process of deciding which
4 technologies it will pursue and to what scale it will
5 pursue things. That decision is coming in June of
6 2008.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

8 CHAIRMAN POWERS: They aren't either.

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

11 CHAIRMAN POWERS: One of those.

12 MEMBER CORRADINI: Either, one of them.
13 Either.

14 MEMBER ARMIJO: So it's open?

15 MR. HELTON: Right, yes.

16 MEMBER ARMIJO: So this is really a
17 placeholder?

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

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

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

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

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

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

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

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

24 MR. SIU: Yes.

25 CHAIRMAN POWERS: As the identical

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

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

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

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

16 MS. LIU: The F.Y. '09 process right now
17 in the budget, we have both budget for FTE and
18 contractor support. And in terms of what would be the
19 contracting vehicle, it would depend what particular
20 activities that we would zero in pending the DOE
21 direction that they are going to come out in June
22 2008.

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

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

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

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

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

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

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1 NRC-licensable.

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

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

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

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

16 MEMBER CORRADINI: I choose NRC's.

17 CHAIRMAN POWERS: NRC's every time.

18 MEMBER CORRADINI: You bet you.

19 CHAIRMAN POWERS: At least it's
20 understandable.

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

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

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

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

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

25 MEMBER CORRADINI: What office is taking

1 the lead on this?

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

4 MEMBER CORRADINI: Including the reactor?

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

7 MEMBER CORRADINI: Okay.

8 MS. LIU: But for the time being --

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

11 MS. LIU: Right, correct.

12 MEMBER CORRADINI: Thank you.

13 CHAIRMAN POWERS: Any other questions?

14 (No response.)

15 CHAIRMAN POWERS: Proceed.

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

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1 looking for a license extension.

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

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

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

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

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

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

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

13 But, again, given where we are in license
14 renewal in the current fleet, we are in the midst of
15 the first round of license renewals, we certainly
16 don't anticipate the next wave as soon as 2009. But
17 2014 to 2019, especially for those plants in the past,
18 some plants have indicated that they at least would
19 like a 10-year window to work through the NRC process
20 as well as cover all the other state and federal
21 impediments to license renewal that they have to go
22 through.

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

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

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

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

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

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1 advanced sensors.

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

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

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

22 And after the scoping study, at the end of
23 '09, there will be a research plan developed to
24 identify what areas we need to go into. I think it's
25 worth stating that a lot of this in terms of material

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

3 So, really, all we are going to be trying
4 to identify is if there is anything new between a
5 60-year and an 80-year life that we need to pay
6 particular attention to or something that at 60 years
7 didn't necessarily cause us a problem, but as we go
8 out to 80 years, the problem moves bigger.

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

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

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

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

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

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

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

7 MEMBER WALLIS: What's funny to this
8 program is that in a way, you've got a deadline around
9 2010 or so. Someone has got to say, "Is the GALL good
10 enough? Do we have to change it? There are some new
11 issues. Do we have to issue new guidance about new
12 problems and so on?"

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

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

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

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

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

10 MR. TREGONING: That's a good --

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

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

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

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

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

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

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

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

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

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

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

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

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

10 MEMBER CORRADINI: So I just had a quick
11 question.

12 MR. TREGONING: Sure.

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

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

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

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

5 MR. TREGONING: Yes.

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

9 MR. TREGONING: Sure.

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

14 MEMBER CORRADINI: Because they may be too
15 conservative?

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

22 MEMBER CORRADINI: Who is doing the
23 advanced fracture mechanics?

24 CHAIRMAN POWERS: What did you say?

25 MEMBER CORRADINI: Who is doing the

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1 advanced fracture mechanics, the last thing you
2 mentioned?

3 MEMBER CORRADINI: Who is doing the
4 advanced fracture mechanics?

5 CHAIRMAN POWERS: Who is doing the
6 advanced fracture mechanics?

7 MR. TREGONING: Who at the NRC?

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

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

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

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

25 CHAIRMAN POWERS: And all you have to

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

2 MEMBER CORRADINI: That's the unit?

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

5 An inside joke. Please continue.

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

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

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

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

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

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

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1 have in the past.

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

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

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

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

16 MR. TREGONING: Yes, right.

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

21 MR. TREGONING: Well, that could be --

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

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

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1 relationship there.

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

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

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

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

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

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

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

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

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

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

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

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

20 MEMBER CORRADINI: So build something.

21 MR. TREGONING: So build something.

22 MEMBER CORRADINI: Field of dreams.
23 Sorry.

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

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

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

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

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

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

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

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

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

15 MR. TREGONING: Let me have Steve jump in.

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

25 Back on the real question you had. The

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

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

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

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

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

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

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

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

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

16 CHAIRMAN POWERS: Said?

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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1 starting to build it in '09.

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

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

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

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1 some significant potential advantage.

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

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

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

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

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

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

5 Is that sufficient?

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

10 Bob?

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

13 (Laughter.)

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

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

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

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

3 And at that point we will have a much
4 better understanding of potentially where we're going
5 to go with this, if we're going to go with this. And
6 pending Commission approval, that will really define,
7 then, what we will be doing and what sort of research
8 plan we will need to develop so that we are ready in
9 '09, as Steve said, to actually start down the road of
10 implementation of this facility, again, assuming it
11 will come to that.

12 MR. ARNDT: Potentially.

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

15 CHAIRMAN POWERS: Go ahead.

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

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

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

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

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

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

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

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

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

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

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

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

23 MEMBER ARMIJO: Yes.

24 MR. HELTON: I am not sure.

25 MEMBER ARMIJO: Well, my opinion having

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

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

12 MR. HELTON: Absolutely.

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

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

22 CHAIRMAN POWERS: And I think that is
23 true.

24 MEMBER ARMIJO: That is kind of pitiful.

25 CHAIRMAN POWERS: But the objective is

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

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

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

25 MR. RUBIN: Can I just address that? Stu

1 Rubin, Office of Research.

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

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

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

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

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

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

5 MR. RUBIN: Yes, yes.

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

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

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

15 MR. RUBIN: Yes, it does.

16 MEMBER SHACK: It does?

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

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

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

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

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

10 MR. HELTON: Thanks, Stu.

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

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

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

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

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

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

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

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

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

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

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

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

25 It strikes me that you have focused very

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

4 I suspect I related before I was asked to
5 look at the issues of computational capabilities more
6 than numerical methods also of hardware. In pursuit
7 of that, I found that today if you ask for a standard
8 engineering computational capability, just ask
9 somebody to set it up for you, that it would be a
10 64-bit processor, I mean, 64 processor installation,
11 with about a megabyte of memory per processing and
12 things like this, huge capability beyond a PC, and
13 that a standard capability would be a virtual reality
14 CAD CAM type of capability.

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

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

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

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

6 CHAIRMAN POWERS: What did you say?

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

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

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

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

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1 design tool.

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

9 Go ahead.

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

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

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

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

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

8 MR. SIU: Yes.

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

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

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

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1 efficient.

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

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

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

25 CHAIRMAN POWERS: In the weapons complex

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

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

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

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

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

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

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

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

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

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

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

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

1 magnitude?

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

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

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

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

25 All three CFD vendors, of the three that

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

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

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

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

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

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

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

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

10 CHAIRMAN POWERS: Mine, too. So.

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

14 MEMBER WALLIS: More than two fluids.

15 MR. HELTON: More than two fluids?

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

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

25 An example of this in the single-phase

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

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

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

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

14 CHAIRMAN POWERS: It makes no difference.

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

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

19 MEMBER WALLIS: Why not?

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

23 MEMBER WALLIS: And that's good enough?

24 CHAIRMAN POWERS: It's good enough.

25 MEMBER WALLIS: You really need to know

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

2 CHAIRMAN POWERS: It's good enough.

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

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

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

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

25 MR. HELTON: They will make colorful

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

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

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

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

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

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

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

1 (Laughter.)

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

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

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

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

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

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

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

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

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

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

15 In fiscal year 2009, we would look at
16 developments specific to the MELCOR code that would
17 allow it to be used in this type of environment.
18 Those would focus on making modifications that would
19 make MELCOR faster running so that you could study
20 multiple cut sets and also any issues that would arise
21 in terms of incorporation into a level 2 and or level
22 2/3 PRA.

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

1 MR. HELTON: I personally am not.

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

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

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

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

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

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

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

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

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

25 CHAIRMAN POWERS: With these advanced

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

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

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

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

17 MR. TINKLER: You mentioned in your last
18 --

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

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

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

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

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

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

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

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

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

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

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

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

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1 how he would actually fulfill it.

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

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

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

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

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

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1 that we see that are not able to incorporate.

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

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

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

15 MEMBER WALLIS: Okay.

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

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

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

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

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

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

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

19 CHAIRMAN POWERS: Thank you.

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

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

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

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

9 CHAIRMAN POWERS: Thank you.

10 MR. HELTON: Okay. Rob?

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

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

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

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

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

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

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

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

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

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

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

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

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

4 MEMBER WALLIS: Those are big things?

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

13 MEMBER WALLIS: Thank you.

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

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

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

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

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

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

11 MR. TREGONING: Right.

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

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

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

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

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

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

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

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

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1 the use of performance-based specifications.

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

9 Any questions on this one before we move
10 forward?

11 (No response.)

12 MR. TREGONING: The next one, I had
13 alluded to this earlier in the life extension beyond
14 60 years. It's entitled "Extended *In Situ* in Real
15 Time Inspection and Monitoring Capabilities." A
16 shorter title could have been "Advanced Sensors," but,
17 you know, the title arose as we were trying to be
18 encompassing because this is a very broad area.

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

1 area that looked at sensors as a whole.

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

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

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

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

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

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

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

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

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

1 whatnot.

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

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

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

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

23 MEMBER CORRADINI: Right.

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

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

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

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

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

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

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

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1 implementing a lot of this new technology

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

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

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

16 I mean, if I take you into a secondary
17 system, I would assume that, for example -- I don't
18 know if you have ever toured a modern day natural gas
19 combined cyclor plant. It takes 2 people to run a
20 150-megawatt plant. That's it, two people on site,
21 ten PCs.

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

24 CHAIRMAN POWERS: And ten guards.

25 MEMBER CORRADINI: For the natural gas

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

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

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

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

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

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

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

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

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

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

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

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

10 MEMBER ARMIJO: They have the ECP sensors.

11 MR. TREGONING: Right.

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

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

21 MEMBER ARMIJO: Right.

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

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1 characterizing residual stress.

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

11 MEMBER SHACK: But a lot of this is
12 economic.

13 MR. TREGONING: Yes.

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

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

25 MEMBER ARMIJO: Did you have anything

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1 specific on characterization of fuel properties?

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

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

15 PARTICIPANT: Fantastic voyage.

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

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

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

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

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

10 PARTICIPANT: All of the time.

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

13 MR. TREGONING: Charlie, do you want to?

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

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

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

1 water.

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

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

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

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1 identified.

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

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

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

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

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

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

25 If we have the notion that there is a

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

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

9 Any other questions on this before we move
10 on?

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

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

17 CHAIRMAN POWERS: Let's continue on.

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

25 And the idea here would be for us to stay

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

7 CHAIRMAN POWERS: A bit elliptical.

8 PARTICIPANT: I think it's intended to be.

9 CHAIRMAN POWERS: Other entities?

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

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

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

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

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

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

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

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

15 MEMBER WALLIS: Heat it up and gone.

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

18 (Laughter.)

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

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

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

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

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

13 PARTICIPANT: Okay. Thank you.

14 MR. NICHOLSON: Tom Nicholson, Office of
15 Research.

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

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

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1 following that work.

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

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

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

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

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1 zone are extremely important.

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

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

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

21 Thank you.

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

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1 PARTICIPANT: That's accurate.

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

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

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

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

1 agencies. And we are one of those agencies.

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

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

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

17 MEMBER ARMIJO: As are all universities.

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

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

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

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

7 MEMBER WALLIS: It's called a major thing.

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

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

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

25 MEMBER WALLIS: One very useful

1 nanotechnology is boron dust as a leak detector.

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

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

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

9 MR. TREGONING: Who knows? Maybe we will
10 develop some advanced sniffers to indicate when we
11 have got boron dust particles floating around
12 containment. So in '09, we are proposing to continue
13 participation in the NNI.

14 Again, working with industry, this is
15 similar to the others: Identify viable applications
16 and then develop plans as appropriate.

17 MEMBER CORRADINI: So I will give you one
18 suggestion here.

19 MR. TREGONING: Okay.

20 MEMBER CORRADINI: I would really suggest
21 you work backwards. Start looking at other industries
22 that have actually gotten something useful out of
23 this.

24 CHAIRMAN POWERS: The two or three?

25 (Laughter.)

1 MEMBER CORRADINI: Well, actually, I have
2 one example. I only have one example. It's in my
3 pocket. I can't find it. There it is. Something
4 small is that. I haven't identified much, but that is
5 one.

6 MR. TREGONING: There are at least a
7 handful of commercial --

8 MEMBER CORRADINI: I'm sure. But
9 seriously I do think that if there are parts of
10 products that can be brought in to improve, obviously,
11 but if it's just so that you guys can use the
12 four-letter word like everybody else can use a
13 four-letter word, I would suggest you look at where
14 else it has been used successfully.

15 MR. TREGONING: Steve might want to
16 elaborate on this. I think that is one of the powers
17 of NNI, the fact that you do have a consortium that is
18 already in place that is examining exactly those
19 questions. I think monitoring those developments will
20 keep us abreast of understanding those applications
21 which had been successful.

22 MEMBER CORRADINI: I mean, just so you can
23 see where I am going with this, for example, I would
24 go to specific industries that make money off of this,
25 like 3M. And I would find out where 3M actually has

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1 engaged in this that actually improves their products
2 or I could pick others.

3 But primarily companies essentially use it
4 in the fundamentals of material science, and that
5 improves the product. And then that might lead you to
6 saying, "Aha. Maybe this."

7 But that is how I would do it. I would
8 work backwards from where people make a lot of money
9 off of it. Then you actually see a real buy-in.

10 CHAIRMAN POWERS: Rob, in this general
11 area but not the specific subject, I see a lot of talk
12 about ion implantation for surface hardening of
13 materials and changing properties of surfaces and
14 materials and things like that.

15 Should there be a corresponding -- or
16 maybe there already is a corresponding activity by NRC
17 on that because that really does work.

18 MEMBER CORRADINI: I was going to say
19 there are facilities. I know the fellow at Sandia who
20 works with one of my colleagues that does exactly this
21 --

22 CHAIRMAN POWERS: Oh, there are huge
23 industries in ion implanting, nitrogen especially, and
24 nitriting surfaces make them hard without damaging the
25 fracture toughness of underlying materials.

1 MEMBER CORRADINI: At the monolayer.

2 MR. TREGONING: Yes. And those are all
3 good applications. And certainly material
4 manipulations in terms of surface modifications and
5 things like that, there has been a lot of prominent
6 research in that area. So that is something that I
7 don't specifically call that out here, but, again,
8 those are relevant areas to look at for monitoring.

9 MEMBER SHACK: Does anybody from Research
10 go to MRS meetings?

11 MEMBER CORRADINI: Yes. There you go.

12 MEMBER SHACK: Send one guy.

13 CHAIRMAN POWERS: And they're excellent,
14 by the way. And you can't send one guy.

15 MEMBER CORRADINI: They're a really
16 excellent meeting.

17 CHAIRMAN POWERS: There are huge numbers
18 of parallel sessions going on.

19 PARTICIPANT: Thousands.

20 PARTICIPANT: A big budget.

21 CHAIRMAN POWERS: But, I mean, it is
22 probably going to pick a society other than the
23 American Nuclear Society, which is top parallel.

24 MEMBER CORRADINI: In terms of usefulness?

25 CHAIRMAN POWERS: In terms of usefulness.

1 MEMBER CORRADINI: I mean, just I don't
2 want to do this to my colleagues, but you have a lot
3 of contractors that get money from you. And a lot of
4 the new material science, you can go to MRS. It
5 wouldn't hurt to actually ask them when you are at MRS
6 as one of your deliverables "What did you see there
7 that could be useful back to the agency relative to
8 applications?" I mean, I'm thinking of a lot of folks
9 from --

10 CHAIRMAN POWERS: I mean, they are
11 required to write a trip report. And usually people
12 struggle with "What am I supposed to write about?"
13 This at least gives them some specificity.

14 PARTICIPANT: If they found out what we
15 were going to, they might not get to go next year.

16 MR. TREGONING: Okay. Those are great
17 suggestions. Thanks. I made notes of that.

18 CHAIRMAN POWERS: Press on, sir.

19 MR. SIU: Okay. This is me, Nathan Siu,
20 Office of Research.

21 This topic is effects of fire on fiber
22 optic cables. We're aware that fiber optic cables are
23 going to be used on new reactor designs. And, in
24 fact, I've been told that maybe some current plants
25 have had some installations.

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1 The Committee is well-aware that we have
2 done a lot of work on fire and done some recent work
3 on the effects of fire on conventional cables in a
4 program called CAROLFIRE, which I believe we're going
5 to be briefing you on sometime in the near future.

6 Naturally we have the same kinds of
7 questions that come up when you bring in a new
8 technology like fiber optics. What is the fragility
9 of the cable with respect to fire effects? And does
10 the cable act as a combustible source of fuel for fire
11 propagation?

12 And you might say, "Well, fiber optics,
13 what's there?" Well, they're jacketed. Like anything
14 else, they have PVC. They have outer coating.

15 CHAIRMAN POWERS: They even have thermal
16 plastic coating.

17 MR. SIU: Yes, right, right. Now, melting
18 of thermal plastic might not be such a bad thing for
19 this versus, let's say, a copper conductor. I don't
20 know. These are things we don't know.

21 So we would, of course, be interested in
22 assessing the fragility and combustibility, at least
23 for the purposes of fire risk assessment and possibly
24 even from a more deterministic standpoint. Obviously
25 --

1 MEMBER WALLIS: I wonder why you picked
2 this out. I mean, fire is going to be a research
3 topic for quite a long time because there are all
4 kinds of unresolved questions. The question just
5 hasn't been resolved very well.

6 MR. SIU: Yes. Again --

7 MEMBER WALLIS: Why did you pick out this
8 particular one?

9 MR. SIU: This gets back to the issue of
10 what is in our regular fire research program versus
11 the long-term aspect. Now, this one --

12 MEMBER WALLIS: Why isn't this in the
13 regular fire research?

14 MR. SIU: It actually is things developed.
15 It might turn out it will end up there. You know,
16 there is a phasing here as we went through our
17 process. We said, "Well, what is the new technology
18 coming down for new reactors?" Fiber optics.

19 And then this wasn't necessarily just our
20 idea. We talked to folks in NRO about this. We put
21 it in the plan. And as people thought about the plan,
22 we said, "Well, maybe it belongs somewhere else."

23 Along the lines of your point and much
24 earlier, it's a good topic to look at. We put it in.
25 It's a planning wedge. At some point later, it might

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1 find its way into another plan. And that is okay.

2 CHAIRMAN POWERS: But that should be the
3 evolution of any of these.

4 MR. SIU: That's right. And that's a
5 valid point. That's right.

6 CHAIRMAN POWERS: Actually, it is a pretty
7 good example. You don't have a lot of fiber optics in
8 your safety systems now, but, I mean, there is a
9 non-zero probability you will in the future.

10 So it is appropriate according to your
11 definitions for the longer-term circuit. But you can
12 well anticipate that it could in the next five years
13 move into the actual fiber circuit program. So it's
14 not a bad example.

15 MR. SIU: And there are requirements in
16 NFPA 804, which is the fire protection program for
17 advanced reactors, which talked to protecting against,
18 for example, spurious actuation.

19 Well, again, we don't have much knowledge
20 about how these would behave under those conditions.
21 Perhaps other industries and I would imagine other
22 industries have a lot of experience already with fires
23 in same telephone exchanges.

24 So the literature source is, of course,
25 the first thing we would do and, if necessary, develop

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1 a model, maybe even identify experiments that we have
2 to perform to quantify parameters in the model.

3 Okay? Next one, please. This one is a
4 general topic, although our fiscal year '09 activities
5 are fairly limited. The broad notion is to improve
6 our empirical database for PRA models when we are
7 talking about new facilities. And by empirical data,
8 now sometimes in PRA-speak, we talk about estimates
9 for failure rates as data. Well, they are data for
10 the models, but they are not the empirical data we're
11 talking about.

12 We're talking here about actual failures
13 or degradations of components in the case, let's say,
14 of a check valve for a passive system or the, again,
15 human performance with the advanced human-machine
16 interface associated with advanced reactors, possibly
17 entirely different modes of operation for advanced
18 chemical facilities, like fuel cycle facilities.

19 So the notion here is to start exploring
20 ways that we can supplement our database. Of course,
21 by its nature, the failure of data tend to be sparse.
22 In many cases, they may be of limited relevance to the
23 new systems. And, of course, the conceptual design
24 would be nonexistent.

25 MEMBER WALLIS: Yes. These are questions

1 you are asking today, aren't they? Why is this
2 long-term research? The passive system PRA is work
3 that is going on now.

4 MR. SIU: Yes.

5 MEMBER WALLIS: HRA carry is going on now.

6 MR. SIU: Right. Now, again, the
7 long-term aspect of this has to do with the
8 application to systems. I mean, clearly there could
9 be some benefit to the current systems, current
10 problems. But the focus would be to look at issues
11 that are associated with the advanced facility; for
12 example, the advanced human-machine interface. That's
13 the sort of thing we could go to other industries that
14 have adopted such systems, let's say the offshore oil
15 industry, which also does PRAs, and try to learn from
16 them, see what data they have.

17 Now, it is exploratory. There are
18 questions about whether the data would be of
19 sufficient quality, applicability, and even whether
20 they are available to us to use.

21 CHAIRMAN POWERS: Nathan, you could call
22 this the acronym AEOD and I one day grow up and go
23 into an entire office in the NRC.

24 MR. SIU: Yes.

25 (Laughter.)

1 MR. SIU: Yes, right. Thank you. Thank
2 you. Well, yes. And where this gets a little
3 different, again -- and we constructed this with
4 knowledge of other programs.

5 I will give you another program that is
6 going on right now in CSNI. It's starting up an
7 activity looking at collecting simulator data for HRA.
8 That's plant simulators and using those in an HRA
9 context.

10 So it's beyond Halden. We tried to avoid
11 that by saying, "Okay. What's another source of
12 information that would be potentially useful." This
13 is where we are going to the non-nuclear sources of
14 information. So we are trying to carve out a piece
15 here that would help the data problem.

16 In fiscal year '09 again, it would be
17 focusing on human reliability. This is one of the
18 things that our program offices asked us to really
19 emphasize, was to try to extract qualitative
20 information about events that occur, not just focus on
21 quantification of the human error probability.

22 So we would make sure that we try to
23 understand the failure mechanisms along the lines of
24 using the structures, again, for our current HRA
25 models.

1 And then as maybe the data are good enough
2 or not to support quantitative risk assessment. That
3 would have to be the result of an evaluation.

4 The next one is related only because,
5 again, the fiscal year '09 for data focused on HRA,
6 but that topic is broader. This particular topic is
7 indeed aimed at HRA.

8 Again, the long-term aspect, both the fact
9 that it's aimed at advanced facilities and, as Dr.
10 Powers pointed out, this work can take a long time to
11 do to make advances in this area --

12 MEMBER WALLIS: Before you extend current
13 HRA capabilities, maybe you need to sort out the
14 current ones.

15 MR. SIU: That's work that's ongoing right
16 now. And you get reported on periodically.

17 CHAIRMAN POWERS: I don't understand the
18 distinction between this and the one on digital I&C
19 and human-machine interface. The human reliability we
20 worry about here is one where the human is interfacing
21 with a machine. I mean, how is this distinct or is
22 this just a subset of that?

23 MR. SIU: This would benefit from that
24 facility that you heard described. For example, I
25 believe you were briefed on the benchmark study for

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1 Halden.

2 CHAIRMAN POWERS: Yes.

3 MR. SIU: So that is a case where it is an
4 open question, how to design a simulator study to
5 support improved quantification HRA models. That's a
6 step. Maybe we get that technology in hand so by the
7 time this neat facility is put together, we know what
8 to do with it from an HRA perspective, quantification
9 perspective. So I see that as the relationship
10 between the two.

11 MEMBER CORRADINI: And this fits into
12 that?

13 MR. SIU: This is the idea of simply how
14 do you do human reliability analysis for an advanced
15 facility? Now, when you get to what is the data you
16 use to perform that assessment or how do you know that
17 your models of performance are correct, you need
18 empirical data and empirical data in this case a
19 controllable source where you can vary the conditions,
20 test hypotheses, and come to the conclusion that this
21 particular context for operator performance is the
22 most challenging one or this is how you should be
23 characterizing stress in a way that can be
24 operationalized in a human reliability analysis.
25 There are lots of issues that you can address using a

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1 simulator, whether it's in the U.S. or in Halden.

2 MEMBER CORRADINI: Right, right. But I
3 guess I am still struggling. I read this. I guess
4 Dana beat me to the question.

5 MR. SIU: Okay.

6 MEMBER CORRADINI: I thought this was a
7 subset of the previous one. This is not. This is the
8 context for all sorts of facilities, reactors, fuel
9 reprocessing facilities, fuel fab facilities. Is that
10 the point of this? That's what I'm still -- I don't
11 understand the context of this relative to the past
12 stuff.

13 MR. SIU: Okay. Just to be clear, the
14 past stuff was the --

15 MEMBER CORRADINI: That was a facility.

16 MR. SIU: Facility?

17 MEMBER CORRADINI: That was a facility.

18 MR. SIU: Okay.

19 MEMBER CORRADINI: Is this the broader
20 context of given all sites of things that are not just
21 reactors, --

22 MR. SIU: Yes.

23 MEMBER CORRADINI: -- how do I develop the
24 database?

25 MR. SIU: No, no, no. This is how you do

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1 the HRA. what methods do you use, what models do you
2 use to employ the methods?

3 CHAIRMAN POWERS: I thought you had a
4 universal answer for that.

5 MEMBER CORRADINI: I thought the model
6 would be --

7 CHAIRMAN POWERS: I thought ATHEANA did
8 everything.

9 MR. SIU: Okay. Maybe we should have gone
10 through my slides in order. In the background, yes,
11 we believe the current frameworks are general. The
12 current frameworks for doing HRA talk about the
13 importance of context and how context influences
14 performance. Okay. That's a nice general statement.
15 And I don't think there is any disagreement about
16 that.

17 Once you start operationalizing that to a
18 maintenance action versus a control room action versus
19 -- I don't know -- a glove box -- I don't know very
20 much, honestly, about fuel cycle facilities, but you
21 can see how the particulars -- you know, what is the
22 particular context? What are the particular rules
23 that the operators are following? What are the
24 importance performance-shaping factors? These things
25 I can certainly envision as changing from situation to

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1 situation.

2 CHAIRMAN POWERS: But what you are talking
3 about are the specifics of application. How can it
4 possibly do this when there are no advanced facilities
5 to do it on?

6 MEMBER CORRADINI: Right. That's why I
7 interpreted it as that if you had an aqueous fuel
8 reprocessing facility like the MOx that they're
9 building or they were going to have a pyro processing
10 or they turned back on the pyro processing on the old
11 Argonne West and you start trying to decide how people
12 would screw it up when they operate it or then you --

13 CHAIRMAN POWERS: Argonne West. There's
14 no screwing up by those guys.

15 MEMBER CORRADINI: That's what I thought.

16 CHAIRMAN POWERS: Oh, I see. Degradation.

17 MEMBER CORRADINI: Or, in other words, you
18 move to Idaho. Now it's screwed up. I thought that's
19 what you said.

20 MR. SIU: In the same way that we talk
21 about general models -- again, let's take maintenance,
22 general models for performing HRA for maintenance for
23 lightwater reactors. And we don't say that you need
24 a different model forth is this plant versus that
25 plant. But the general category of maintenance is

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1 sort of the general kind of activities are performed.

2 My hope -- this may be unfounded -- would
3 be that the advanced facilities -- obviously we would
4 have to pick something. It's not totally abstract.
5 You can characterize them at a sufficient level to say
6 these are the kinds of activities that will be
7 performed based on reasonable extrapolations or
8 reasonable knowledge of what the design is going to
9 look like but not down to what is the exact procedure.

10 MEMBER CORRADINI: Okay. I see.

11 MR. SIU: This is methods.

12 MEMBER CORRADINI: I understand.

13 MR. SIU: This is not the model.

14 MEMBER CORRADINI: So, then, just a
15 thought. Given that these are chemical, at least the
16 fuel reprocessing facility looks a whole lot like any
17 sort of cascade process in chemical engineering, I
18 would assume that there are industries like Dow or
19 DuPont that you could go and see how they do their
20 reliability or their human failure analysis on their
21 facility.

22 MR. SIU: Absolutely. Absolutely. We are
23 also familiar enough with the chemical process
24 industry that in many cases, we know that they have
25 not tried to be quantitative in their approach.

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1 MEMBER CORRADINI: Really?

2 MR. SIU: They like the HASOP approach.

3 MEMBER CORRADINI: Which is all
4 qualitative?

5 MR. SIU: Yes. What if this happens?
6 What if that happens? And possibly because maybe they
7 don't have quite so many barriers in terms of
8 defense-in-depth. An upset happens, and it's without
9 some action.

10 CHAIRMAN POWERS: So the more reliance on
11 the operational staff you had.

12 MR. SIU: Yes.

13 CHAIRMAN POWERS: And a general approach
14 tends to be more societal than it does individual.
15 The society of what person --

16 MR. SIU: Oh, the culture. I didn't know
17 what you meant.

18 CHAIRMAN POWERS: Yes. So it surprised
19 me, but I still am not going to sit here and say,
20 "This looks like an application to send." I don't
21 know how you apply until you have got a facility."

22 MR. SIU: Well, yes. Again, it may be an
23 unreasonable expectation to say that we can
24 characterize the activities to such a level that we
25 can then do the identification of issues. Again, we

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1 go through these exercises right now. And we do the
2 PIRTS for human factors issues associated with
3 advanced

4 We're talking fairly general terms, but we
5 know about navigation through screens. We know about
6 the different interface devices that people have to
7 work with. So without talking exactly the design, we
8 know the general characteristics that you have to deal
9 with.

10 Now, the question from an HRA perspective
11 would be, do we have a way to address navigation
12 through screens? Does it matter? Is that going to
13 affect the outcome at the human failure event level,
14 which is a fairly high course level of modeling in the
15 PRA?

16 So I think there are questions that we
17 would be addressing. I am not saying at this point
18 that we even assume that we are going to need new
19 methods. It's again identifying what are the issues
20 and can current methods address this.

21 CHAIRMAN POWERS: It has always seemed to
22 me that the issue that you have with these advanced
23 facilities is there is nothing really for the operator
24 to do, protracted periods, which is just looking at a
25 screen. And they're set up in many cases to react

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1 passively in the event of an event.

2 MR. SIU: Right.

3 CHAIRMAN POWERS: And the issue then
4 becomes one strictly of errors of commission.

5 MR. SIU: Let me give you a slightly
6 different twist on that. Some years ago we looked at
7 a PRA for a plant that the human factors specification
8 for the plant was that the crew was going to look at
9 what was going on, develop a good understanding of
10 what was happening, and react to that.

11 The PRA HRA that was done for it was a
12 very conventional THERP analysis, which is basically
13 they followed a procedure, boom, boom, boom, boom,
14 boom, here is the answer. It seemed that there was a
15 mismatch between the approach taken or the viewpoints
16 of the two groups.

17 If one is to say, "Well, I am truly in a
18 mode of sit back and think about what is going on," I
19 would ask whether the implementation of even our
20 ATHEANA approach and how I would do that, what would
21 I need to do to make sure that I am comfortable with
22 that," again, clearly our implementation to this point
23 has been largely on procedure-oriented responses. So
24 I think there are differences in the approach or there
25 could be.

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1 Okay. This one is related to the one that
2 Don talked about earlier. This talks about
3 quantitative risk assessment methods. And, again,
4 it's a recognition that work is going on outside NRC.
5 The answers are being made. The Committee raised the
6 issue or the question of binary decision diagrams and
7 whether we should be using those more in our PRAs.

8 There are other tools that are being
9 developed now: Bayesian belief nets. Don mentioned
10 simulation. That's another tool that's been used in
11 the context of risk assessment.

12 And so there have been some applications
13 of current systems, but we see that there is some
14 likelihood that they will also be employed for the
15 advanced designs.

16 So our notion here is to, again, perform
17 a scoping study, assess where we are in terms of these
18 technologies, and really hopefully develop an informed
19 decision as to whether we should be proceeding along
20 any of these fronts.

21 Certainly we need to stay aware of them
22 because I fully expect to see some of these being
23 employed.

24 MEMBER WALLIS: Bayesian belief? I
25 thought Bayesians never believed anything.

1 (Laughter.)

2 MR. SIU: Everything is belief in
3 Bayesians. Subjective probability.

4 MEMBER WALLIS: Yes. Probability is a
5 state of knowledge. It's not a belief.

6 MR. SIU: Okay. Well --

7 (Laughter.)

8 MR. SIU: Boy, you have faith.

9 CHAIRMAN POWERS: They don't believe
10 anything? Bayesians believe everything.

11 MEMBER WALLIS: It can be sort of
12 revolutionized by new evidence all the time. So it's
13 a pretty rocky belief, isn't it?

14 CHAIRMAN POWERS: Like much of science.

15 MR. SIU: If you can't change your belief
16 after you have been given evidence, I guess that's a
17 worse problem. No. Actually, that's been used in at
18 least one application I understand in a safety culture
19 problem. We can see this as well in treatment, for
20 example, of aging systems and how one might start
21 bringing physical models into the PRAs without going
22 to full-out simulation.

23 CHAIRMAN POWERS: I mean, my feeling is
24 that it is absolutely important for the NRC to
25 continuously look at the structure that it has created

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1 in here.

2 I mean, you guys have made PRA. Okay? I
3 mean, it's your invention. But there are lots of
4 different ways to skin that cat. And you have got to
5 continuously go look and see if the way that you have
6 done it is the best way or if there are better ways.

7 And it's a very difficult job because you
8 have a well-developed technique for doing things. And
9 you can say, "Well, this new way doesn't do everything
10 my old way of doing it." Yes. But it hasn't had the
11 benefit of all of that development. So you've got to
12 be a pretty perspicacious person to look and say, "No.
13 That one has promise."

14 I hope you do lots of that sort of stuff
15 and even to the point of encouraging people to invent
16 new ways of doing things. We talked about that
17 earlier in connection with APEX and stuff like that.

18 I think that's good because that is your
19 tool. That is your regulatory. I mean, it is
20 secondary only to defense-in-depth now in your
21 regulatory framework that you have set up. So you had
22 better be defining continuously the state of the art
23 in that field because you have tied your whole agency
24 to it.

25 MR. SIU: Okay. Last one.

1 CHAIRMAN POWERS: Now --

2 (Laughter.)

3 CHAIRMAN POWERS: -- we don't have
4 Professor Apostolakis here to humiliate on this
5 regard.

6 MR. SIU: I am a poor stand-in.

7 MEMBER CORRADINI: Are you going to use
8 this chart tomorrow?

9 CHAIRMAN POWERS: I encourage you not to
10 use this tomorrow, even though we only have an hour
11 and a half.

12 MR. SIU: This would be one I wouldn't
13 show. This would be one. I have a few others.

14 Let me explain what we have here. The
15 formal decision-making methods, of course, cover a
16 wide range of tools, techniques. It's not just the
17 multi-attribute utility theory at the back end of
18 this, but it's also the way you structure the problem,
19 the way you identify your alternatives, the way you do
20 trade-offs, which doesn't have to be, again, a fully
21 quantitative approach.

22 And there are lots of ways of doing it.
23 Books have been written about it, a tremendous amount
24 of work. NRC has done some work in this area.

25 I think it's fair to say that in some ways

1 we use these techniques, certainly in terms of when we
2 come up with problems like this research program. We
3 try to start off with a clear specification of what we
4 are trying to do, what are the ways that we would
5 indicate how they are successful.

6 This kind of thing also happens with
7 development of other research programs and other kinds
8 of decision prompts. And we don't necessarily make it
9 easy for the next go-round to say, "Okay. We will
10 build on what was done before and take it up further."
11 We don't have ways to make the trade-off problem
12 easier.

13 It seems to me that while formal
14 decision-making in general requires a lot of thought
15 and resources, it's conceivable that there are ways
16 that we can reduce that level of effort and so to make
17 the effort bounce more with the benefit.

18 So the idea behind this activity would be,
19 again, we're not trying to revamp how we are doing
20 everything in the agency at this point. The premise
21 is that there is benefit to be gained from using these
22 methods, but we wanted to find out what are really the
23 stumbling blocks in all of the things that we might be
24 able to do to reduce the --

25 MEMBER WALLIS: Is this ever used in the

1 agency? It seems to me that the biggest decisions are
2 made by managers with no formal analysis whatsoever.

3 CHAIRMAN POWERS: That's what he's talking
4 about.

5 MEMBER WALLIS: Is there any precedent for
6 decisions having been made?

7 MR. SIU: Yes, there is some. There is
8 some. Actually, I was aware of an activity a while
9 ago in the Office of Research that was prioritizing
10 research activities. And it used the analytical
11 hierarchical process. And, again, the word I got
12 afterwards, "Boy, that was a lot of work" and "Gee,
13 should we do that again?"

14 But to me, once you start putting it in
15 that frame, you say, "Well, maybe that starts making
16 it more technical." You have a lot of information you
17 need to elicit and to process. Are there ways or
18 tools that could be developed that would lower the
19 amount of energy required to encourage the use of it?

20 But you can't encourage the use of it if
21 you don't have success somewhere. So that's the
22 notion of a pilot. Find a pilot or some area where we
23 are willing to try it out, identify what were the
24 issues, and figure out what should we do once that
25 pilot is finished.

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1 So it's a quite modest activity, but I
2 think it has a value just because I have some belief
3 in the value of the use of formal methods. I mean,
4 just as you described, if we're continually informal
5 in our decision-making methods, we say we will never
6 change that, then that's where we are. But if we're
7 willing to say we might allow the possibility that we
8 could do better in some circumstances or at least make
9 it easier to arrive at the decision, then that would
10 be some value in doing this work.

11 CHAIRMAN POWERS: You cite on the slide
12 "successfully used in other fields." I mean, it's
13 surprising, other institutions, other places, but
14 fields. That's interesting.

15 MR. SIU: Well, other institutions,
16 outside NRC. Again, if we don't limit ourselves to
17 saying "formal methods" means the full-blown
18 application of the KINA RIFA approach, some aspects of
19 it, starting with the formal identification of
20 objectives and working your way down, specification
21 problem. You know, there's that -- what do they call
22 it? -- the proact framework.

23 MEMBER WALLIS: There are some beautiful
24 books written on this stuff. I just wonder if it ever
25 gets used.

1 MR. SIU: I guess my understanding is that
2 it is, at least to some extent. Now, again, whether
3 all of the formalisms are used I'm not clear on that.
4 Prasad can expand on that. I don't know if you want
5 to expand on that any further.

6 MR. KADAMBI: My name is Prasad Kadambi.
7 I'm in the Office of Research.

8 I guess what I would point out is a useful
9 place to begin thinking about some of these techniques
10 is in the area of performance-based regulation, the
11 guidance that the staff developed in that area, in
12 fact, the ACRS suggested that we should be really
13 making sure that we put decision thresholds in such a
14 way that, you know, in a structured approach, it would
15 make sense to measure performance appropriate to the
16 kind of flexibility and the safety impacts.

17 So all I would say is that the work that
18 the staff has done offers some context in which if we
19 were able for the NRC environment, you know, and for
20 the kinds of issues that we face, if you are better
21 able to use these techniques which are available, that
22 that would be the objective.

23 MR. SIU: Other questions? I think that
24 was the last one in just the last --

25 MS. LIU: Okay. Now coming to the last

1 slide to close out our formal presentation for this
2 afternoon, I just want to read some of the points that
3 we have talked about earlier today, that we have
4 developed the initial version of this long-term
5 research plan for 2009. And the priorities are now
6 being deliberated as part of the F.Y. '09 budget
7 process within the agency.

8 And any additional revisions to the
9 candidate research topic can be addressed as a part of
10 the reprioritization next year when we look at the '09
11 and F.Y. '10 budget as part of your input and other
12 stakeholders' input.

13 And also we discussed a process for how we
14 intend to do the periodic update and, lastly, that a
15 couple of options exist for possibly requiring any
16 reprioritization of the long-term research activities
17 and also funding mechanism.

18 I just want to leave you with a couple of
19 other observations based on our interaction today.
20 When we got the assignment December last year to
21 develop this per request of Ryan, we were very
22 enthusiastic, even though we realized that we don't
23 have a lot of time to do this. So we are designing
24 the process as we go to make sure that we will be in
25 time to at least put a planning wedge in the F.Y. '09

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1 budget process.

2 We will be the first one to admit that we
3 can do everything better and we can think through
4 everything in more detail and at the same time we want
5 to make sure that we capitalize on the opportunity to
6 get the long-term research thinking into a budget
7 planning process.

8 And also, as any of these activities start
9 to evolve into more detail, we scope out what we
10 actually are going to be doing, then they will come
11 off from the long-term research plan and into its own
12 research plan. So that way we will continue to use
13 this vehicle as a way to generate new ideas and before
14 we are looking.

15 We will be using the lessons learned and
16 all the observations that we have gathered from this
17 initial effort to make sure that in the future update,
18 we will follow a more systematic process. And then we
19 will address all of the issues that have come up
20 during this particular effort.

21 One thing that I personally have observed
22 is that not only because of the short-term and
23 long-term we have, also there probably is some level
24 of speculation about how serious this agency truly is
25 in terms of investing in forward-looking research.

1 So the level of success of all the
2 candidate activities that we have identified in this
3 particular iteration while certainly sentencing of the
4 other people who are sitting on the fence line
5 regarding whether they really want to be formally
6 engaged and be more enthusiastic, and as Professor
7 Wallis indicates, to really let the activities start
8 flourishing and open the floodgate.

9 So we understand that this is an important
10 adventure for the agency. This is certainly one giant
11 step, we feel, that integrating the agency effort in
12 doing forward-looking research.

13 And we would welcome any input that you
14 have. Thank you.

15 CHAIRMAN POWERS: Thank you.

16 III. DISCUSSION

17 CHAIRMAN POWERS: We have one chore I want
18 to continue on the record. And that is to advise this
19 team, this excellent team, of what they should bring
20 forward to the full Committee.

21 I have suggested to them that they begin
22 with Christiana's talk, eliminate the process material
23 but outline first their objectives and the criteria
24 they have used for selecting projects, get to the list
25 of projects, and then round out the presentation by

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1 exploring a few. And that would probably be no more
2 than five of the projects they had selected.

3 That was my suggestion to them. Do
4 members have anything they want to add or disagree
5 with?

6 MEMBER CORRADINI: That sounds good. I
7 like that. That would make for a nice --

8 MEMBER WALLIS: I would like to hear
9 someone's perspective, though. Are these suggestions
10 for projects or are these all ones that you would
11 pursue if you got the money?

12 MS. LIU: These are ones that we have put
13 into our F.Y. '09 budget. At the same time, if there
14 are other topical areas that come into our attention
15 and we have a fixed pot of resources, we can go in and
16 reprioritize. In other words, we can not do certain
17 activities that would --

18 MEMBER WALLIS: Once you prioritize, some
19 of these may be dropped.

20 MS. LIU: Correct.

21 MEMBER WALLIS: Okay.

22 MS. LIU: Correct.

23 CHAIRMAN POWERS: Please?

24 MR. TREGONING: As well, let me comment on
25 that. Some of these we are pursuing in '07 and '08.

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1 So some of these may be dropped as a result of
2 progress in '07 and '08. So this is one of those
3 processes that we're continually revisiting in terms
4 of prioritization.

5 CHAIRMAN POWERS: And that, too, is a
6 worthwhile point to make, that this is a dynamic
7 process.

8 MEMBER SHACK: Yes. This notion that they
9 move from one program to the other I think is a point
10 to be made.

11 CHAIRMAN POWERS: It is. Okay. If there
12 are no other comments, then I will go off the record.
13 And we will discuss what we bring forward to the full
14 Committee. We are now off the record.

15 (Whereupon, the foregoing matter was
16 concluded at 4:07 p.m.)

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CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

Name of Proceeding: Advisory Committee on
Reactor Safeguards
Safety Research Subcommittee

Docket Number: n/a

Location: Rockville, MD

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.



Charles Morrison
Official Reporter
Neal R. Gross & Co., Inc.



Agency Long-Term Research Plan Development

Christiana Lui, Don Helton, Nathan Siu, Rob Tregoning
Office of Nuclear Regulatory Research

May 2, 2007



Meeting Purpose

- Describe the process for developing the Long-Term Research Plan (LTRP)
- Discuss a process for updating the LTRP (FY10, FY11, etc.)
- Summarize proposed FY09 LTRP activities
- Solicit ACRS views on FY09 research activities, activities for future consideration, and ACRS role and the process



Background

- FY 2008 NRC Budget SRM (COMDEK-06-0001, Item 16 on "Forward Looking Regulatory Research")
"...maintain a careful watch for emerging technical/regulatory issues that will require initiation of research beginning in the nearer term...to ensure research will support such needs in a timely manner...to ensure long-term needs are addressed."
- Continued Commission interest

3



Objectives and Scope

- Agency-wide Long-Term regulatory research plan
 - Focus on long-term research needs (starting in FY09) that support possible new program areas or emerging technologies that may have future nuclear applications
 - Incorporate current, near-term, and long-running research needs largely via reference to existing planning documents.
- Planning and communication tool
- Living document that will be updated periodically
- High-level description of research activities

4



LTRP Development: Step One

- RES-led effort, initiated in December 2006
- Generated ideas from a variety of internal sources
 - Staff from RES (largely), FSME, NMSS, NRO, NRR and NSIR
 - Existing and formative internal and external (e.g., DOE, CSNI, IRSN, STUK) research plans
 - Past ACRS recommendations
 - Previous/ongoing interactions with the industry, DOE and international organizations to the extent feasible

5



LTRP Development: Step One

- Achieved multi-office concurrence
- Submitted candidate activities for consideration as part of the FY09 budget process
- Provided LTRP to Commission (SECY-07-0068) with commitments to
 - Finalize the proposed plan for FY09
 - Implement a process for updating the long-term research plan

6



Step One: Lessons-Learned

- Good staff participation
 - Encourage additional and continual staff participation
 - Most initial proposals were not long-term; staff focused on current and near-term needs
- Information organization a challenge
- Current suite of research plans are work in progress
 - Detailed plans not available in all technical areas
 - Many are internal documents; varying level of program office buy-in
 - Generally focus on current needs (next 2-3 years)
- Timing of future LTRP updates is important to inform the budget and ensure consistency
- LTRP could be foundation for agency-wide coordination
 - Increase transparency and traceability of the planning process
 - Requires resources to continue and maintain

7



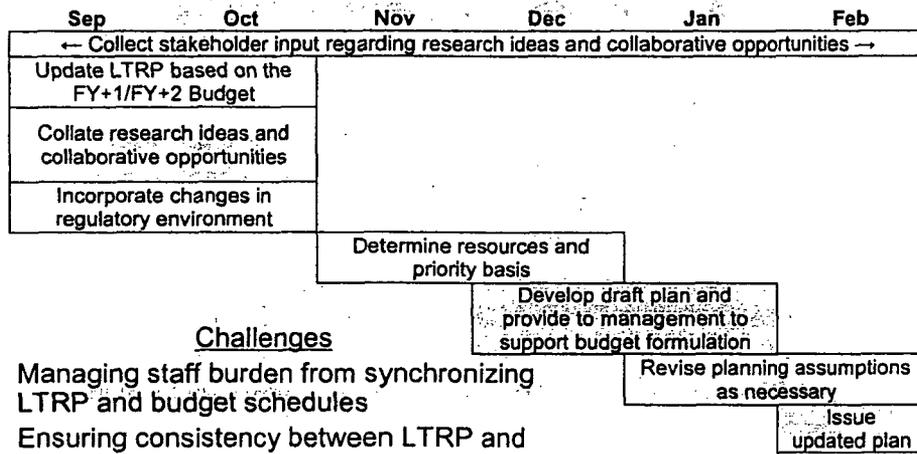
LTRP Development: Step Two

- Finalize FY-09 LTRP
 - Continue to interact with other NRC program offices
 - Seek ACRS and ACNW review and input
 - Interact with external stakeholders, such as DOE, industry, universities, national labs and international organizations
 - Explore collaborative opportunities to leverage resources
 - Develop schedules, major milestones, and deliverables as appropriate
 - Develop a communication plan
 - Provide proposed final FY 2009 plan to Commission by July 2007
- Implement process for updating LTRP
 - Synchronize with agency's current planning cycle and process
 - Evaluate the need to develop separate prioritization scheme

8



Proposed Process for Updating LTRP



9



Proposed ACRS Role

- ACRS currently provides research recommendations resulting from
 - Review of research activities
 - Review of licensing/regulatory decisions
 - Commission requests
- Staff proposes to
 - Consider applicability of each recommendation with respect to LTRP
 - Prioritize recommendations consistently with input from other stakeholders
 - Consider funding in FY+2 budget or reallocation of FY+1 budget as appropriate
 - Align the FY 2010 plan, as feasible, with ACRS FY 2008 recommendations for additional research topics

10



Identifying Future Long-Term Research Activities: Considerations

- Consistency with the agency's strategic plan
- Research being conducted by industry and other organizations
- Possible collaborative arrangements with other organizations, including international cooperatives
- Potential benefits of research
- Current state-of-the-art in technical area (e.g., high-temperature material performance) and viability for nuclear applications
- Required technical/regulatory development and challenges
- Research schedule required to support the licensing/oversight process

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Prioritization of Long-Term Research

- Current agency budgeting process generally favors current and near-term research needs
- Current LTRP prioritization
 - Step 1
 - Management screening of initial ideas (as discussed)
 - Prioritization using the FY 2009 budget process
 - Indicate the potential need for an alternative prioritization to accommodate long-term research activities and identify considerations
 - Step 2
 - Evaluate the need to develop an alternative prioritization scheme

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LTRP Funding: Possible Options

1. Use existing budgeting process for long-term activities
 - No deviation
 - Small deviation from current scheme (e.g., simply highlighting long-term aspects of the current strategic goals and outcomes)
 - Large deviation (e.g., re-weighting of the strategic goals, developing a completely separate ranking system)

2. Exclude long-term research activities from budgeting process and prioritize separately
 - Pursue alternative strategies for funding long-term research (e.g., remove from fee base)
 - designated level of funds

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LTRP Report Structure

- Executive Summary
- Introduction
- Candidate Research Projects
 - GNEP
 - License Renewal Beyond 60 Years
 - Test Facilities
 - Cross-Cutting Research

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Summary of Proposed Activities

- DOE Global Nuclear Energy Partnership
- Reactor License Renewal Beyond 60 Years
- Test Facilities
 - Integrated Digital I&C and Human Machine Interface Research Facility
 - Integral Effects Test Facilities for Advanced non-LWRs
- Cross-Cutting and Emergent Technologies
 - Advanced Analytical Capabilities
 - Advanced Computational Methods
 - Multiphase Computational Fluid Dynamics Capability
 - Advanced Modeling Techniques for Level 2/3 PRA
 - Advanced Offsite Consequence Code

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Summary of Proposed Activities, cont.

- Cross-Cutting & Emergent Technologies (cont.)
 - Advanced Fabrication Techniques
 - Extended In-Situ and Real-Time Inspection & Monitoring Techniques
 - Offsite Mitigation Strategies
 - Nanotechnology for Nuclear Power Applications
 - Fire Effects on Fiber-Optic Cables
 - Risk Assessment for Adv. Reactor/Fuel Cycle Facilities
 - Empirical Data for Risk Assessment
 - HRA Methods for Advanced Facilities
 - Advanced Quantitative Risk Assessment Methods
 - Formal Decision Analysis Methods

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Candidate Activity Descriptions



GNEP

- Objective
 - Develop regulatory infrastructure needs associated with DOE's GNEP program
- Technical Background
 - NRC already interacting with DOE on this issue
 - Staff is evaluating licensing options, including any necessary rulemakings
 - Depending on technology selection, will likely involve technologies such as:
 - Chemical separation for reprocessing
 - fission products, transuranics, Uranium
 - Fast reactor (LMR) transuranic transmutation



GNEP

- Uses
 - Technical bases development for licensing a
 - consolidated fuel treatment center and
 - an advanced burner reactor
 - Associated risk strategies and acceptance criteria
- FY09 Activities
 - Specific activities depend on DOE's selection of technologies (June 2008)

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Reactor License Renewal Beyond 60 Years

- Objective
 - Evaluate and update, as necessary, the technical basis for supporting evaluation of possible requests for license renewal beyond 60 years
- Technical Background
 - Modifications of safety-related systems, structures, and components may increase impetus for license renewal.
 - No regulatory limit which precludes additional life renewal beyond 60 years.
 - Informal DOE inquiry about possibility of renewal beyond 60 years, but no formal letter of intent received.
 - Earliest renewal application is assumed between 2014 – 2019.
 - Current technical bases are the GALL and GEIS reports.

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Reactor License Renewal Beyond 60 Years

- Uses
 - Support GALL and GEIS modifications, as necessary, to extend technical bases beyond 60 years.
 - Technical information for updating related SRPs (NUREG-1800 & NUREG-1555, Supplement 1) and Regulatory Guides (1.188 and 4.2)
- FY-09 Activities
 - Identify possible supporting extended in-situ and real time instrumentation and monitoring techniques
 - Conduct scoping study to assess and prioritize technical issues
 - Aging of critical passive structures, systems, and components
 - Aging of electrical and instrumentation systems
 - Develop research plan

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Integrated Digital I&C and Human Machine Interfaces Research Facility

- Objectives
 - Develop facility for digital I&C systems which is integrated with a full-scale, reconfigurable simulator to improve the realism, applicability, and efficiency of planned research
- Technical Background
 - Research is currently performed at several different national laboratories, universities and international research facilities.
 - NRC is acquiring several digital safety systems that are being used (or proposed for use) in the industry for evaluation at these different facilities.
 - Use of multiple facilities is inefficient and does not allow for realistic simulation of the various representative digital I&C and human machine interfaces

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Integrated Digital I&C and Human Machine Interfaces Research Facility

- **Uses**
 - Single, integrated test facility would provide capability to independently confirm analyses of proposed I&C systems.
 - Facility would also provide data to validate digital system risk and reliability models currently being developed.
 - Modular, reconfigurable human factors simulator would permit evaluation of all expected plant control room and HMI designs.
- **FY-09 Activities**
 - Prepare detailed options paper (early FY 2008)
 - Pending Commission approval of paper
 - NRC and industry will jointly establish facility requirements and initiate development.
 - Staff will complete detailed facility development and operations plan.

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Integral Effects Test Facilities for Advanced non-LWRs

- **Objective**
 - Availability of facilities for regulatory activities associated with advanced non-LWRs
- **Technical Background**
 - Early LWR experience demonstrates the need for these facilities (technical bases to support licensing decisions)
- **Uses**
 - Ensuring adequacy of safety criteria
 - Ensuring adequacy of licensees' analytical tools
 - Development and validation of the agency's tools
- **FY09 Activities**
 - Scoping and prioritizing regulatory research needs for a wide range of technical disciplines

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Advanced Computational Methods

- Objective
 - Identify / evaluate external developments:
 - problems relevant to a broad range of applications
 - improved integrated cross-disciplinary analysis capabilities
- Technical Background
 - Prompted by improvements in the internal and external computational environment
 - Increased importance due to “best estimate + uncertainty”
- Uses
 - Sensitivity analysis for multi-parameter problems
 - Quantitative uncertainty analysis
 - Direct system simulation
- FY09 Activities
 - Scoping level assessment to identify, evaluate and recommend needed research activities (generic and/or application-specific)

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Multiphase Computational Fluid Dynamics

- Objective
 - Extend NRC's single-phase CFD capability to multi-phase
- Technical Background
 - Used in other industries
 - More applications being seen in the nuclear industry (especially in other countries)
- Uses
 - Two-phase issues in current and new reactors (e.g., DNB)
 - Two-phase / two-fluid issues in advanced reactors
- FY09 Activities
 - Evaluate domestic/international collaboration opportunities
 - Examine existing commercial/research tools
 - Benchmark versus simple, well-characterized experiments

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Advanced Modeling Techniques for Level 2/3 PRA

- Objective
 - Provide integral, quantitative, predictive capability to directly support Level 2/3 PRA (alternative to the APET approach)
- Technical Background
 - Important phenomena-based insights incorporated in to the agency's severe accident computer code
 - Current Level 2 treatment relies on a simplified logic-based approach and static approximations of behavior

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Advanced Modeling Techniques for Level 2/3 PRA

- Uses
 - Eliminate reliance on simplified LERF in favor of quantified Level 3 or discrete release categories
 - Capability of considering alternate risk metrics
- FY09 Activities
 - MELCOR developments specific to this application
 - Investigation of fast-running MELCOR incorporation into Level 2 PRA framework

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Advanced Offsite Consequence Code

- Objective
 - Development of a next-generation offsite consequence code
- Technical Background
 - Current codes (MACCS2, RASCAL) utilize simplified transport models (Gaussian plume/puff)
 - Code architecture limits the ability to evolve
- Uses
 - Offsite consequence calculations for postulated fission product releases
- FY09 Activities
 - Evaluate currently available models
 - Investigate implementation issues and potential benefits in effectiveness/realism
 - Develop a code development plan (if justified)

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Advanced Fabrication Techniques

- Objectives
 - Evaluate the performance of new construction, fabrication, and manufacturing techniques for nuclear applications
 - Assess use of performance-based specifications
- Technical Background
 - New techniques are being considered for new and next generation nuclear systems, structures, and components.
 - Many techniques may greatly decrease the construction schedule and relative cost of new plants, while simultaneously improving quality.
 - Industries are moving from prescriptive to performance-based specifications.
 - It's unknown if nuclear applications present unique performance challenges.

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Advanced Fabrication Techniques

- Uses
 - Support staff review and development of updated guidance for new nuclear power plants construction
- FY-09 Activities
 - Coordinate with DOE and industry to identify viable construction and component manufacturing techniques (FY 2007- 2008)
 - Identify preliminary technical and regulatory issues (FY 2007 – 2008)
 - Conduct systematic scoping study to fully identify and prioritize technical issues that may have adverse nuclear safety ramifications
 - Evaluate existing laboratory and service performance of techniques and assess the use of performance-based specifications
 - Develop detailed research plan

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Extended In-Situ and Real-time Inspection & Monitoring Capabilities

- Objectives
 - Expand monitoring capabilities
 - Improve evaluation of critical nuclear systems and components both during normal and accident conditions
- Technical Background
 - Development of miniaturized, cost-effective, and advanced sensors capable of performing real-time monitoring
 - Wide-spread use in automotive, chemical processing, aerospace, and other commercial industries
 - Commercial nuclear and material facilities often use older technologies.
 - DOE's Nuclear Energy Research Initiative has investigated a number of these new sensors and techniques.

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Extended In-Situ and Real-time Inspection & Monitoring Capabilities

- **Uses**
 - Monitor real-time material degradation
 - Characterize residual stress
 - Assess radionuclides/chemical species in ground water and soil
 - Characterize fuel properties
 - Monitor severe accident conditions
- **FY-09 Activities**
 - Select promising sensor candidates for industry use
 - Evaluate regulatory and safety considerations to verify reliability, accuracy, and acceptability for nuclear service.
 - Develop research plan, culminating in regulatory approval, for viable candidates

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Offsite Mitigation Strategies

- **Objective**
 - Monitor developments in the area of capture and cleanup of radioactive materials
- **Technical Background**
 - Other entities are performing research for airborne scavenging technologies
- **Uses**
 - Identification of potentially beneficial mitigation technologies
- **FY09 Activities**
 - Monitor external activities in this area, including:
 - Airborne mitigation systems
 - Non-airborne on-site delivery systems

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Nanotechnology for Nuclear Power Applications

- Objectives
 - Identify candidate nuclear applications of nanotechnology
 - Develop plans to support regulatory use of identified technologies
- Technical Background
 - NRC is partner in National Nanotechnology Initiative (NNI), a nanotechnology research and development program among 25 Federal agencies.
 - One NNI objective is to identify the applied research and development needed to transition scientific discoveries into commercial applications.

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Nanotechnology for Nuclear Power Applications

- Uses
 - Condition-based sensing for early potential fault detection
 - Security of information technology systems
 - Nonvolatile, radiation-hard, low-power, high-density, random access memory
 - Enhancement of containment or reactor coolant system heat transfer during accident conditions
- FY-09 Activities
 - Continue participation in NNI to monitor scientific developments
 - Identify, with industry, viable nuclear applications
 - Develop research plans to assess the potential regulatory applications of these technologies and develop acceptance criteria for their use

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Fire Effects on Fiber Optic Cables

- **Objective**
 - Develop and validate fire models for fiber optic cables
- **Background**
 - Substantial work on conventional cables (e.g., CAROLFIRE)
 - Potential questions with introduction of fiber optics cables
 - Fragility (cables as targets)
 - Combustibility (cables as intermediate fire sources)
- **Potential Uses**
 - Assessments of acceptability
 - Risk-informed applications (e.g., fire protection)
- **FY09 Activities**
 - Initiate development (including literature search, model framework development, identification of empirical data needs and sources)

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Empirical Data for Risk Assessment (Advanced Reactors and Fuel Cycle Facilities)

- **Objective**
 - Improve empirical basis for PRA models in key areas (e.g., HRA, passive systems)
- **Background**
 - Failure event data: sparse, of limited relevance, or non-existent
 - Non-nuclear sources may be relevant, but need to address quality, applicability, and availability
- **FY 09 Activities**
 - Initiate pilot project
 - Identify, collect, and analyze non-nuclear data relevant to human performance during accidents
 - Derive qualitative failure mechanism information and associated risk assessment implications
 - Assess ability of data to support quantitative risk assessment

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HRA Methods for Advanced Facilities

- Objective
 - Extend current HRA capabilities to advanced reactor and fuel cycle facilities
- Background
 - Current frameworks are general
 - Application work to date focuses on operating facilities
 - Ongoing benchmarking study may provide information relevant to extensions
- FY09 Activities
 - Perform scoping study
 - Identify key HRA issues for advanced facilities
 - Evaluate ability of current HRA methods and data to support risk assessments for these facilities

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Advanced Quantitative Risk Assessment Methods (Advanced Reactors and Fuel Cycle Facilities)

- Objective
 - Evaluate potentially promising advanced quantitative methods
- Background
 - Improved methods have been developed
 - Numerical solution of logic-based models
 - Explicit representation of deterministic and probabilistic relationships
 - Some applications to current systems
 - Potential value in addressing advanced systems
- FY09 Activities
 - Scoping studies to assess the state, costs, and benefits of selected methods:
 - Binary Decision Diagrams
 - Bayesian Belief Nets
 - Simulation-based risk assessment approaches

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Formal Decision Analysis Methods

- Objective
 - Identify and evaluate barriers preventing more widespread use of formal methods
- Background
 - Successfully used in other fields
 - Limited use within agency
- FY09 Activities
 - Pilot study
 - Identify key implementation issues
 - Develop recommendations for follow-on work

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Summary

- Staff has developed an initial Long-Term Research Plan for FY 2009
 - Activities are being prioritized as part of the FY2009 NRC budget development
 - Any additions or deletions to the draft FY 2009 plan can be addressed as part of the reprioritization
- Staff has discussed a process for identifying candidate research and periodically updating the plan consistent with the agency's planning process
 - Proposal on incorporation of ACRS recommendations into updates
- Several options exist for prioritizing and funding long-term research

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