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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
(ACRS)

512th FULL COMMITTEE MEETING

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THURSDAY,

MAY 6, 2004

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ROCKVILLE, MARYLAND

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The Committee met at the Nuclear
Regulatory Commission, Two White Flint North, Room
T2B3, 11545 Rockville Pike, at 8:30 a.m., Dr. Mario V.
Bonaca, Chairman, presiding.

COMMITTEE MEMBERS PRESENT:

MARIO V. BONACA, Chairman

STEPHEN L. ROSEN, At-Large

GEORGE E. APOSTOLAKIS, Member

F. PETER FORD, Member

THOMAS S. KRESS, Member

GRAHAM M. LEITCH, Member

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1 COMMITTEE MEMBERS PRESENT (Continued):

2 DANA A. POWERS, Member

3 VICTOR H. RANSOM, Member

4 WILLIAM J. SHACK, Member

5 JOHN D. SIEBER, Member

6

7 NRC STAFF PRESENT:

8 DAVID ALBERSTEIN

9 TONY ATTARD

10 TOM BOYCE

11 CINDI CARPENTER

12 MIKE CASH

13 STEPHANIE COFFIN

14 ANNE COTTINGHAM

15 JOHN CRAIG

16 A. EL-BASSIONI

17 P.J. HABIGHORSE

18 DONNIE HARRISON

19 WAYNE HARRISON

20 JIANG HONG

21 BILL KEMPER

22 FELIX KILLAR

23 STEPHEN KLEMENTOWICZ

24 RALPH LANDRY

25 KEVIN LaVIE

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1 NRC STAFF PRESENT (Continued):

2 ALAN LEVIN

3 ERASMIA LOIS

4 STU MAGRUDER

5 BOB MARTIN

6 KEVIN McCOY

7 GEORGE MEYER

8 RALPH MEYER

9 CARL PAPERIELLO

10 GARETH PARRY

11 MARK REINHART

12 STACIE SAKAI

13 N.T. SALTOS

14 UNDINE SHOOP

15 WILKINS SMITH

16 BILL STILLWELL

17 T.R. TJADER

18 JARED WERMIEL

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P R O C E E D I N G S

(8:29 a.m.)

CHAIRMAN BONACA: Good morning. The meeting will now come to order.

This is the second day of the 512th meeting of the Advisory Committee on Reactor Safeguards.

During today's meeting, the committee will consider the following:

Use of mixed oxide lead test assemblies at the Catawba Nuclear Station;

Risk management technical specifications;

Trial and pilot implementation of Regulatory Guide 1.200, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-informed Activities";

Good practices for implementing human reliability analysis;

And then preparation of ACRS reports.

Dr. John Larkins is the Designated Federal Official for the initial portion of the meeting.

We have received no written comments from members of the public regarding today's session. We have received a request from NEI for time to make oral statements regarding Regulatory Guide 1.200, and from

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1 NEI and Dr. Lyman of Union of Concerned Scientists
2 regarding the use of MOX fuel lead test assemblies at
3 the Catawba Nuclear Station.

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

9 Also, I want to remind you that during
10 lunchtime today, between 12:45 and 1:15 p.m., Mr.
11 Paperiello, who is the new RES Director, will meet
12 with the members informally to discuss his vision for
13 the Office of Research. So I think you'll essentially
14 have half an hour for lunch and then half an hour is
15 indicated to Mr. Paperiello.

16 I will begin with some items of current
17 interest. You have in front of you, in fact, this
18 package, items of interest and in it you'll find
19 speeches from the Commissioners.

20 You'll find also an NRC announcement, mid-
21 page, Office of Public Affairs, "NRC provides update
22 or review process for Vermont Yankee operator
23 request," where it is indicated that there will be a
24 special review of Vermont Yankee power up-rate and
25 also the ACRS will be involved in that review.

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1 There is also an interesting article at
2 the end of the package regarding MSPI. We have shown
3 for the level of interest in MSPI, and there is
4 information there regarding that indicator.

5 Before we start with the first item on the
6 agenda, I would like to recognize Mr. Jain. Mr. Jain
7 has been with ACRS staff for a year and will be
8 leaving on May 28th, 2004 to join Research. We
9 appreciate the outstanding technical support that he
10 has provided us in several matters, including license
11 renewal applications and recently the resolution of
12 the ACRS recommendations related to the DPO on steam
13 generator tube integrity. Hopefully we will finalize
14 that report today so that it will be done while you're
15 still here with us, and also the support he has
16 provided on good practices for human reliability
17 analysis.

18 Thank you very much and good luck.

19 (Applause.)

20 CHAIRMAN BONACA: With that we can move to
21 the first item on the agenda. Dr. Powers, if you
22 could.

23 All right. I know from good memory
24 that --

25 DR. POWERS: Agendas are precious items.

1 CHAIRMAN BONACA: It was mine and I lent
2 it to you.

3 DR. POWERS: Well, that was your mistake.

4 CHAIRMAN BONACA: The first item on the
5 agenda is the MOX fuel LTA, and Dr. Powers will lead
6 us through that presentation.

7 DR. POWERS: Right. It's titled "Use of
8 Mixed Oxide Lead Test Assemblies at the Catawba
9 Nuclear Station."

10 CHAIRMAN BONACA: Very good.

11 DR. POWERS: I think most of the members
12 are aware there's a national policy to dispose of
13 excess weapons grade plutonium as mixed oxide fuel in
14 commercial nuclear power reactors. This is, of
15 course, the first time that we made a conscious effort
16 to use mixed oxide or MOX fuel in nuclear power
17 stations.

18 And it is true that there is some
19 significant experience with mixed oxide fuel in power
20 reactors in Europe especially. But that experience is
21 with reactor grade plutonium that does not have the
22 enrichment of the 239 isotope, the weapons grade
23 plutonium has.

24 As a consequence, we don't know as much
25 about mixed oxide fuel as we would like to know, and

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1 the way we obtain some of that information that we
2 need to have to use mixed oxide, of course, is to use
3 lead test assemblies, and that's what we're
4 considering, is the safety of using some mixed oxide
5 lead test assemblies in the Catawba reactor.

6 Our interest is can this be done with
7 adequate assurances of the public health and safety.

8 The Fuel Subcommittee met with the folks
9 from Catawba, the staff, and the Union of Concerned
10 Scientists to discuss this use of mixed oxide lead
11 test assemblies to some detail, and of course, we have
12 asked those various institutions to present to the
13 committee far more material than the time slot allows.

14 And, indeed, we're going to go through
15 this with some dispatch in order to transmit all of
16 the information that we've accumulated on this issue.

17 Before the committee, of course, is a
18 safety evaluation report you've all seen and read in
19 some detail. There is an administrative difficulty in
20 that the core that was analyzed did not recognize that
21 some other lead test assemblies not connected with the
22 MOX will be in the core, and that particular issue has
23 to be sorted out before we can actually proceed to
24 communicate to the Commission our findings on the lead
25 test assemblies.

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1 But at this stage, I think what it is is
2 to try to summarize what the status is on the use of
3 lead test assemblies in the Catawba reactors at this
4 point.

5 So I think we'll start by asking Mr.
6 Steven Nesbit of Duke Power to present the applicant's
7 case for these lead test assemblies.

8 MR. NESBIT: Shall I do it from up there
9 or over here?

10 DR. POWERS: It's strictly up to you, but
11 up here is probably easier for all concerned. They'll
12 even give you a chair if you're nice.

13 Sometimes people sit; sometimes they
14 stand. It's pretty much up to you.

15 MR. NESBIT: No, this will be fine.

16 DR. POWERS: And, Steve, I want to try to
17 hold you to about 45 minutes or less on this.

18 MR. NESBIT: I did a run-through. Just
19 hit that button for now. I did a run-through, and I
20 got through it in 45 minutes. Of course, that's
21 assuming no questions. Some people would say that's
22 a low probability event.

23 DR. POWERS: That is a silly assumption.

24 (Laughter.)

25 MR. NESBIT: But what I'm going to do is

1 take you at your word before that people can actually
2 read on their own. So I'm not going to read all of
3 the slides. I'll be very quick about as much of this
4 as I can, and hopefully we'll get through it in about
5 45 minutes.

6 Good morning. I'm Steve Nesbit. I'm the
7 mixed oxide fuel manager for Duke Power.

8 Duke Power is the utility that will be
9 using mixed oxide fuel in its reactors as part of the
10 plutonium disposition program, and we have put forward
11 a license amendment request to the Nuclear Regulatory
12 Commission to let us use four MOX fuel lead assemblies
13 at Catawba.

14 I have a brief introduction, and then
15 we'll talk about some general MOX fuel
16 characteristics, our safety evaluation, our
17 environmental evaluation, and a summary.

18 I think Dr. Powers has covered the
19 disposition program sufficiently. I'm not going to
20 belabor this. I'll make one point. The MOX fuel
21 lead assembly program at Catawba is an essential part
22 of the program. Without that the MOX fuel project
23 doesn't go forward, and the plutonium disposition
24 program doesn't go forward.

25 Here's an outline of what we're going to

1 do or, in some cases, what we're actually doing.
2 Polishing plutonium oxide powder at Los Alamos
3 National Laboratory.

4 DR. POWERS: You might want to just for
5 clarification purposes explain what you mean by
6 "polishing."

7 MR. NESBIT: Okay. What we're doing or
8 what LANL is doing and has essentially wrapped up now
9 is they have put the plutonium oxide that's derived
10 from weapons material through an aqueous process in
11 which it's dissolved and then precipitated out, and
12 the result of that process is the removal of
13 impurities, such as gallium that you may have heard
14 something about, and the production of a plutonium
15 oxide powder that meets the spec and is consistent
16 with the powder that's used in the European programs.

17 That work is essentially done. The
18 plutonium oxide paddle will be transported over to
19 Europe to a facility called Cadarache, which is
20 operated by COGEMA, and there it will be fabricated
21 into mixed oxide fuel pellets, and the pellets will be
22 loaded into rods. The rods will be welded shut.

23 The rods will then be transported to
24 another facility operated by COGEMA in France. That's
25 the Melox facility, and there the rods will be bundled

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1 into fuel assemblies. The completed fuel assemblies
2 will be transported back to the United States, to the
3 Catawba Nuclear Station, where they'll be loaded into
4 the reactor in the spring of next year, about a year
5 from now.

6 And then ultimately after the fuels are
7 irradiated, we will have in addition to pool-side post
8 irradiation examination, some hot cell post
9 irradiation examination as planned for Oak Ridge
10 National Lab.

11 DR. APOSTOLAKIS: How is this
12 transportation done from the U.S. to France and back?

13 MR. NESBIT: Inside the U.S. the
14 transportation will be done by Department of Energy
15 safeguards transporters. It's the same approach that
16 they use to transport sensitive nuclear material in
17 the DOE complex.

18 The material will be transferred to Europe
19 by ship using PNTL special purpose ships that have
20 been used in past shipments of sensitive nuclear
21 material between Europe and Japan.

22 Within Europe the plutonium oxide will be
23 transferred in the same manner that it's typically
24 done, by truck in France as part of commercial
25 reprocessing. And then going backwards it's just the

1 reverse.

2 Catawba Nuclear Station is where the MOX
3 fuel will be used. It's located in South Carolina.
4 It's 3,411 megawatt standard Westinghouse four-loop,
5 pressurized water reactor operated by Duke Power.

6 I will note there's 193 fuel assemblies in
7 the core. So we're talking about four assemblies out
8 of that number. It is a plant that has ice condenser
9 containment design, and the Catawba and McGuire
10 reactors all share a common primary system and reactor
11 core design. Those are the reactors that the MOX fuel
12 will ultimately be used at in larger quantity.

13 The irradiation plans. We plan to
14 irradiate at least some of the fuel three cycles. The
15 first cycle will start up in the spring, will load the
16 assemblies in positions that have typical power for
17 first burn fuel, but not limiting power. It won't be
18 the peak assemblies in the core. We'll do pool-side
19 post irradiation examination after the first cycle.

20 Similarly, in the second cycle, we'll load
21 it in a similar location for second burn fuel. By the
22 end of the second cycle, we expect a peak burn-up of
23 approximately 48 gigawatt days per ton on the peak rod
24 in the MOX assembly.

25 So that's a pretty heavy duty to put on a

1 lead test assembly program, but again, they won't be
2 limiting.

3 We'll discharge some of the assemblies
4 after two cycles and prepare rods for shipment to the
5 lab for hot cell PIE. We'll also load one or more of
6 the assemblies back for a third cycle of irradiation
7 to take the burn-up up close to 60,000 gigawatt days
8 per ton.

9 DR. SIEBER: That cycle three burn-up
10 there is incorrect, right?

11 MR. NESBIT: I hope not. Sixty thousand,
12 that would be a high burn-up for gigawatt days per
13 ton.

14 DR. SIEBER: It certainly would.

15 MR. NESBIT: That's 60 gigawatt days per
16 ton or 60,000 megawatt days per ton.

17 Here's a schematic diagram of the core
18 design that we have in mind right now. I will point
19 out a couple of things in this diagram. This is a
20 core-to-core representation. These are the axes of
21 symmetry.

22 This is the MOX fuel, the magenta or
23 purple, and it's located in a location, core location
24 C8 that's instrumented fully, which means each MOX
25 assembly will have the ability to send an in-core

1 instrument up and get a detection signal on the flux
2 there.

3 Oh, great.

4 So that's the MOX assemblies. The feed
5 for resident fuel, which is Westinghouse RFA fuel, is
6 shown in the yellow, and then the once burned and
7 twice burned are in the white.

8 This assembly here, which is supposed to
9 be aqua -- it may not come through -- is the next
10 generation fuel retest assembly from the Westinghouse
11 program, and we've defined an area around the MOX
12 assembly so that we won't load the two right next to
13 each other to preclude any interactions between the
14 two lead test assemblies.

15 This is the current loading pattern as the
16 final fuel cycle design was approved. However, I will
17 note that as cycle operations go forward, sometimes
18 these things change a little bit. We tweak the
19 enrichments and things like that.

20 Required regulatory approvals. This
21 license amendment request is related to a number of
22 other regulatory approvals, and I won't go through
23 them in detail, but there's a number of things in
24 front of the Commission.

25 Now I'd like to move on and talk about

1 some of the characteristics and attributes of mixed
2 oxide fuel that pertain to this license amendment
3 request. The fuel is going to be manufactured using
4 the MIMAS process. I believe the ACRS has looked at
5 this through the MOX fuel fabrication facility, and so
6 I'm not going to belabor the MIMAS process.

7 I'll note a couple of things. There's a
8 lot of experience with this in Europe. That's with
9 reactor grade material versus we're using weapons
10 grade material with more Plutonium-239 and less
11 Plutonium-240.

12 The pellet structure that comes out of
13 this manufacturing process is uniform on a macroscopic
14 scale. However, when you get to the microscopic
15 scale, it becomes heterogeneous, and we'll show some
16 pictures of that in a minute.

17 There's plutonium-rich particles,
18 agglomerates, and there's the depleted uranium oxide
19 that the powder is blended with, and then there's a
20 coating phase of intermediate plutonium concentration.

21 Here's the process, and I'll just point
22 out one or two things. The first step is a primary
23 blend of plutonium oxide powder, uranium oxide powder.
24 We're going to blend this for the weapons grade
25 material in a 20-80 ratio plutonium to uranium, and

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1 that's what produces the plutonium rich particles,
2 which are subsequently blended in a second process
3 with depleted uranium oxide powder.

4 DR. SIEBER: Why did you choose tails
5 material as opposed to natural uranium as the carrier?

6 MR. NESBIT: Well, tails is what's
7 predominantly used in Europe. So we're maintaining
8 the greatest level of consistency with the European
9 experience that way. That's the primary reason.

10 Also, I mean --

11 DR. SIEBER: It has some disadvantages,
12 too, right? For example, you know that the plutonium
13 grains create hot spots in the fuel, and those spots
14 are hotter if the surrounding matrix is depleted in U-
15 235, and so you have greater fission gas release. You
16 have a more pronounced fueling effect. You have a
17 greater potential in some accident scenarios for clad
18 perforation.

19 So I'm curious as to why that decision was
20 made.

21 MR. NESBIT: Well, I guess I don't agree
22 that there's a significant effect there between the
23 depleted versus the natural uranium in the matrix.
24 Either way the predominant number of fissions are
25 going to be in the plutonium, not in the uranium.

1 DR. SIEBER: That's true.

2 MR. NESBIT: And, you know, again, as I
3 said, the experience base in Europe has been
4 predominantly with uranium oxide, and I think --

5 DR. SIEBER: Well, there is a U.S.
6 experience base that came out of Hanford in the '70s
7 in the plutonium utilization project there that really
8 concentrated on the effect of grain size, and I'm sure
9 that you folks have looked at that.

10 MR. NESBIT: We have, and there is some
11 experience in Europe using natural uranium instead of
12 depleted uranium, but again --

13 DR. SIEBER: Well, that's not the key
14 issue. The key issue is how big are the grains.

15 DR. POWERS: It seems to me that the
16 difference here between what comes out of the MIMAS
17 process and what was looked at at Hanford is you have
18 a great deal more of the plutonium actually dissolved
19 in the uranium matrix than they did, which can
20 ameliorate some of the thermal gradient between the
21 particle and the matrix itself.

22 MR. NESBIT: And we're going to see some
23 pictures of that in just a minute

24 DR. SIEBER: Well, the specs on the
25 milling process that goes on here comes out with a

1 pretty fine material. So the concern is not
2 overwhelming.

3 MR. NESBIT: Yeah. They actually put this
4 slide in the right place for a change.

5 Here's a picture, an EPMA image of an
6 unirradiated MOX pellet produced by MIMAS, and this is
7 the unvarnished picture up here, and these are the
8 computer enhanced versions down here.

9 I'm going to concentrate on this lower
10 picture, and what you see here in the red, these are
11 the plutonium rich particles, also referred to as
12 agglomerates, with significant fraction of the
13 material being plutonium.

14 Then in the blue phase here, this is the
15 material that's essentially all uranium, and then the
16 intermediate phase, the green shows what's called the
17 coating phase where there's an intermediate quantity
18 of plutonium that's commensurate with the overall
19 average in the pellet.

20 So the point I guess I'm trying to make
21 with this picture is that while the characterization
22 of plutonium rich particles surrounded by a sea of
23 uranium is not entirely accurate here. The actual
24 structure on the micronic scale, while it is
25 heterogeneous, is not as completely discrete as you

1 might think.

2 Here's a picture of the plot, a plot of
3 the percent of the plutonium total versus the size of
4 the agglomerates, and all of the agglomerates add up
5 in this case to about 25 percent of the overall
6 plutonium. So the majority is actually in the coating
7 phase, not in the plutonium rich particle phase.

8 And as you can see, as the size of the
9 particle goes up, there's less and less of the
10 plutonium actually there. In the largest particles,
11 there's relatively little of the total plutonium
12 there.

13 Some of the characteristics of the fuel.
14 We're talking about sintered oxide pellets,
15 predominantly uranium. In our case it's going to be
16 at least 95 percent uranium and the remainder
17 plutonium.

18 Material properties are similar to LEU
19 fuel because of the fact that the uranium controls
20 that.

21 There's lower decay heat from MOX fuel
22 during the time frame of interest for transient
23 accident analyses, and for these four lead assemblies,
24 there's a relatively small impact on global physics
25 parameters. I'm going to show a little bit more about

1 that.

2 Now, here's a plot of thermal conductivity
3 versus temperature. This is unirradiated, but as you
4 can see, the top line is uranium oxide, and the bottom
5 is MOX at a six percent plutonium concentration. So
6 there is a difference, but it has the same shape, and
7 it's very close.

8 Heat capacity. We had some discussion of
9 this slide in the subcommittee meeting. Actually it
10 was a different slide. I changed slides because of
11 that discussion.

12 The other slide showed that when you get
13 to higher and higher plutonium concentrations you can
14 get a significant difference in heat capacity. In this
15 case, we've looked at it with about 4.37 percent
16 plutonium, which is nominal for what we're doing, and
17 the two curves, MOX and UO2 are virtually an overlay.

18 These don't reflect the discontinuity
19 associated with the phase change at about 2,600
20 degrees that we talked about some. We went back and
21 looked at the literature. The most recent literature
22 does acknowledge that discontinuity exists, but it
23 recommends using a smooth curve because the magnitude
24 is not significant. So that's what this curve
25 reflects.

1 In terms of decay heat, what I plotted
2 here is the ratio of the MOX decay heat over LEU decay
3 heat for a nominal fuel assembly at I think a burn-up
4 of 40 or 45,000 megawatt days per ton. Let me see if
5 I get the units right this time.

6 And so at one they're equal, and that
7 crossover point comes at about three days after
8 shutdown. Before then MOX has less decay heat than
9 LEU.

10 DR. ROSEN: I only see one line on that
11 curve.

12 MR. NESBIT: There is only one line. It's
13 a ratio plotted. So, for example, at 40, it's about
14 .99, say.

15 DR. ROSEN: Oh, I see.

16 MR. NESBIT: So the MOX is one percent
17 lower than LEU there.

18 DR. ROSEN: It's a ratio.

19 MR. NESBIT: Core physics parameters. We
20 looked at a core and substituted four MOX assemblies
21 for four LEU assemblies and looked at some of the key
22 parameters that affect the accident analyses, like
23 delayed neutron fraction, feedback coefficients, et
24 cetera.

25 The differences in terms of these

1 coefficients are three percent or less, and as a
2 result, these are the same kind of variations that you
3 see typically in cycle-to-cycle reload design. So
4 there's really no impact of the MOX assemblies on the
5 global core physics parameters.

6 The lead assemblies. This would be
7 different for batches of fuel with significant
8 quantities.

9 DR. SIEBER: Delayed neutron fraction
10 though is different than the equivalent energy of LEU
11 fuel, right? It's smaller?

12 MR. NESBIT: Plutonium has a smaller
13 delayed neutron fraction, significantly smaller than
14 uranium, but when you look at it on a core-wide basis,
15 the impact of the four assemblies is relatively minor.

16 DR. SIEBER: Yeah, but some days you're
17 going to have more than four assemblies.

18 MR. NESBIT: Right.

19 DR. SIEBER: So that will effectively
20 change the transient characteristics of the core.

21 MR. NESBIT: Yes, it will. Yes, it will.

22 DR. SIEBER: And I guess for lead test
23 assemblies it really doesn't make a lot of difference,
24 these little changes. On the other hand, you wouldn't
25 be putting them in if you didn't anticipate full core

1 loads.

2 MR. NESBIT: And we're in the process of
3 doing the safety analyses right now for the full core
4 case. Of course, European reactors have operated with
5 core fractions up to 36 percent mixed oxide fuel and
6 accommodated within the base reactor design.

7 DR. SIEBER: The current European fuel
8 experience is not weapons grade plutonium.

9 MR. NESBIT: It is not. That's correct.

10 Let's talk about the MOX fuel lead
11 assembly description for a second. What we've done is
12 we've taken mixed oxide fuel pellets and put them into
13 an existing United States uranium oxide fuel design,
14 which is the Advanced Mark-BW design, and there's
15 information presented in Framatome topical reports on
16 this and also on the impact of putting the mixed oxide
17 fuel in there.

18 Here's a picture. This is the Advanced
19 Mark-BW design with the MOX pellets. You can't tell.
20 There's a couple of things I'll point out about this.

21 This does use M5 cladding for the fuel
22 rods and also for the intermediate grids, and it
23 contains standard state-of-the-art fuel assembly
24 design features like bottom nozzle to trap debris,
25 reconstitutable, et cetera.

1 DR. ROSEN: Has M5 been used in this
2 country before?

3 MR. NESBIT: Yes, it has. It's been used
4 pretty significantly in this country. For example,
5 our Oconee units are using M5 cladding right now, and
6 TMI, a number of plants have been using M5, and of
7 course, it has been used over in Europe as well.

8 DR. SIEBER: It's approved here.

9 MR. NESBIT: Well, it's approved on a
10 plant-by-plant basis.

11 DR. SIEBER: Right.

12 DR. POWERS: I mean, to be clear, that's
13 only because the regulation is written for zero.

14 MR. NESBIT: Right.

15 DR. POWERS: So you have to do a plant-by-
16 plant application on it.

17 MR. NESBIT: That's right, and in fact,
18 part of our application has been an exemption request
19 to go out with the use of M5 here.

20 Concerning a comparison of the fuel
21 assembly designs, this is the MOX assembly in this
22 column. This is the Advanced Mark-BW assembly in this
23 column, and I'm just going to talk about a couple of
24 differences.

25 We have a slightly longer rod for the MOX

1 assembly, and this allows to accommodate for greater
2 fission gas release, and our design for batch burn-up
3 is going to be 50,000 rather than the current LEU
4 design is 62,000, and there's actually been lead test
5 assemblies in the UO2 space that have gone up to, I
6 think, 72,000.

7 But we are planning to take the lead
8 assembly up higher than that.

9 DR. ROSEN: Higher than 72?

10 MR. NESBIT: Excuse me. Higher than 50,
11 which is the anticipated batch limit, but we'll take
12 it up to about 57,000.

13 CHAIRMAN BONACA: You said before that up
14 to 36 percent of European cores have had plutonium MOX
15 fuel. You don't mean just a batch. I mean, it means
16 that also when you get the twice burn, the three times
17 burn --

18 MR. NESBIT: Looking at the table core --

19 CHAIRMAN BONACA: -- the maximum number is
20 going to be 36 percent?

21 MR. NESBIT: -- 36 percent of the
22 assemblies in the total core have been MOX fuel
23 assemblies.

24 CHAIRMAN BONACA: Okay. And when you load
25 it that way, I mean, do you have to have special

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1 planning on how you load it?

2 I mean, the concern must be probably more
3 limiting fuel?

4 MR. NESBIT: Well, the information we've
5 gotten from France and Germany -- it's actually German
6 plant that went 36 percent. The French plants go to
7 30 -- is that there's really no major impact from a
8 plant perspective.

9 Now, the French did add some control rods.
10 The Germans did not. Our analyses indicate that we're
11 not going to need to.

12 CHAIRMAN BONACA: Yeah, okay.

13 MR. NESBIT: I want to talk for a
14 minute --

15 DR. LEITCH: Steve, before you move on,
16 this right-hand column, is this your more or less
17 standard fuel now, or is this the NGF fuel?

18 MR. NESBIT: No, this is the Framatome
19 Advanced Mark-BW design. We do not have any fuel this
20 design in our reactors right now. There's some fuel
21 of this design in the North Anna Reactors.

22 We did use a substantial amount of Mark-BW
23 fuel, which is similar, but did not have a couple of
24 intermediate mixing vein (phonetic) grids, "we" at
25 McGuire and Catawba. So we have substantial

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1 experience with a similar fuel design, but the co-
2 resident fuel, I didn't put any information up on
3 that. It's the Westinghouse RFA design.

4 It is also very similar. I'll point out
5 that the pressure drop difference between the two, the
6 MOX assembly and the RFA assembly, is less than four
7 percent overall. So very similar hydraulically.

8 DR. LEITCH: And the NGF lead test
9 assemblies?

10 MR. NESBIT: I didn't provide information
11 on that specifically. The NGF assemblies are similar
12 to the RFA assemblies. They have additional grids and
13 a couple of other design features that really don't
14 affect the hydraulics that much. They have a greater
15 pressure drop than the RFA assemblies, but it's still
16 reasonably close to the RFA and to the mod.

17 DR. LEITCH: Okay.

18 DR. SIEBER: I'd like to ask a real quick
19 question about Catawba. Each fuel assembly at Catawba
20 either has a control rod in it, a source rod, or a
21 flow limiting device. Do you have any assemblies that
22 don't have one or those three things?

23 MR. NESBIT: Actually we load burnable
24 poison rod assemblies in a lot of our assemblies.

25 DR. SIEBER: Okay, but you have something

1 in every assembly.

2 MR. NESBIT: Actually, you know, I know
3 that's true of Oconee. I think that's true at McGuire
4 and Catawba, too.

5 DR. SIEBER: Okay. Because if you don't
6 sometimes folks either break them or they're stuck or
7 they don't feel like putting them in. What it does is
8 it short circuits the flood.

9 MR. NESBIT: Right. You have to account
10 for any --

11 DR. SIEBER: So I would feel more
12 comfortable if you had a good balance flow there as
13 opposed to some open holes where you don't have
14 anything inserted.

15 MR. NESBIT: I believe that's the case,
16 and the MOX assemblies, we're going to put a burnable
17 poison rod assembly in for the first cycle at least,
18 possibly even the second.

19 DR. SIEBER: Okay.

20 MR. NESBIT: I'll talk briefly about the
21 MOX fuel experience base. There's been more than
22 3,700 fuel assemblies delivered by Framatome, both the
23 France part and the part that's formerly Sieman's in
24 Germany by the end of 2003. So there's been a lot of
25 MOX fuel used in Europe, and there's currently more

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1 than 30 reactors, easy mixed oxide fuel.

2 There's a couple of plants currently
3 making MIMAS MOX fuel and one making SBR MOX fuel, are
4 staring up in Britain.

5 There's been a lot of test programs as
6 well in Europe, hot cell examinations, test reactor
7 radiations, et cetera, looking at some of these things
8 that you might expect, pellet cladding interaction,
9 fission gas release, et cetera.

10 The result of the test programs in very
11 high level summary is that in many characteristics,
12 the behavior is exactly the same as LEU fuel. As you
13 might expect, the cladding corrosion is not affected
14 by the fuel pellet material. It's the same.

15 It has been observed there's higher
16 fission gas release than LEU fuel. I'll talk a little
17 bit about that in a minute.

18 There's a better pellet cladding
19 mechanical interaction reports fuel due to the
20 different characteristics of the fuel pellet, and a
21 lot of this information is summarized in a recent IAEA
22 Technical Document No. 415 if you care to look at
23 that.

24 Here's a picture, a radial cut of a MOX
25 pellet at 50 gigawatt days per ton, and there's really

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1 not anything too remarkable to say about this. It's
2 standard appearance that you might get for, I guess,
3 used fuel.

4 Fission gas release is primarily
5 attributed to a couple of factors. One is the MOX
6 fuel in Europe tends to run at higher powers and,
7 therefore, higher temperatures towards the end of its
8 burn-up range, and that promotes fission gas release,
9 and there's also the impact of the lower thermal
10 conductivity.

11 And there's also the fact that, as we
12 talked about before, the micro structure has plutonium
13 rich particles, and there tends to be local high burn-
14 up zones which can lead to the formation of voids with
15 fission gas there.

16 The differences really manifest themselves
17 medium to high burn-up as indicated by this next
18 slide, which shows some French data for MOX and LEU.
19 MOX is in the green. LEU is in the red, and as you
20 can see, the increase starts at an earlier burn-up,
21 and this is probably due primarily to the difference
22 in the linear power of the rods that are being
23 irradiated and then the MOX is generally higher at the
24 higher burn-ups.

25 Again, that's something we've tried to

1 take into account in the fuel assembly design.

2 Concerning the safety evaluations that
3 we've performed, before I get on with this, I guess I
4 probably ought to address in just a couple of minutes
5 the weapons grade versus reactor grade because I don't
6 have a slide that really goes over that, but let me
7 address what we see as the impact of weapons grade
8 versus reactor grade.

9 The primary impact is that because you're
10 using weapons grade plutonium with less parasitic
11 Plutonium 240 and more of the good stuff, 239, you
12 have to put less plutonium in the fuel rod to get the
13 same energy out.

14 As a result, the characteristics of the
15 weapons grade fuel are closer to the characteristics
16 of uranium fuel than would be reactor grade MOX fuel.

17 Similarly, I didn't bring the slide, but
18 if you look at a plot of reactivity versus burn-up,
19 the performance of the weapons grade fuel is closer to
20 low enriched uranium fuel in terms of how the
21 reactivity let-down curve with burn-up goes than is
22 reactor grade MOX fuel.

23 So as far as we've been able to tell,
24 every difference between the two is beneficial if you
25 view beneficial as being more like uranium fuel.

1 Our bases for saying that we can operate
2 safely with MOX fuel -- I should have said lead
3 assemblies up here -- the similarity between the two
4 fuel types, LEU and MOX. There's an extensive
5 European experience base which we've discussed with
6 greater quantities of mixed oxide fuel. We've had
7 U.S. MOX test programs and lead assembly programs here
8 in the United States in the past, as we discussed
9 earlier.

10 We're using a proven fuel assembly design,
11 and we've done specific analyses and evaluations for
12 the use of the fuel, like Catawba, to be sure we
13 remain within our regulatory limits.

14 Let's talk about LOCAL analyses. Before
15 I get into what we did, let me just say right off the
16 bat LOCA analyses are primarily about the reactor
17 coolant system and the cladding, and the fuel pellet
18 really doesn't play a big role in the LOCA analysis.
19 When you see what we changed to account for the MOX in
20 the model, that becomes apparent.

21 We started with Framatome's Appendix K
22 large break LOCA evaluation model, and Framatome did
23 this work, or AREVA, if you prefer. That's based on
24 RELAP 5, Mod 2. We looked at what the MOX impacts
25 ought to be and where appropriate we modified the

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1 evaluation model to address them.

2 We did an apples-to-apples, MOX-to-LEU
3 comparison, and then we did some specific analyses to
4 develop MOX specific lead assembly LOCA limits.

5 These are the areas that we looked at in
6 terms of does the evaluation model need to be changed
7 to address the thermal conductivity. A small effect,
8 but we're going to use the MOX -- we did use the MOX
9 specific properties. Volumetric heat capacity was
10 essentially no effect. We continued using LEU.

11 Decay heat, again, we talked earlier about
12 MOX. It's conservative to use the LEU. That's what
13 we did. We used the standard Framatome evaluation
14 model. Again, this is Appendix K, not best estimate.
15 So it has the 120 percent conservatism factor.

16 Void reactivity and delayed neutron
17 fractions, clear characteristics which for MOX would
18 tend to shut the power down quickly, more quickly than
19 LEU field. So we just assumed the same
20 characteristics for LEU overall.

21 And then the initial fuel temperature can
22 be different. We used MOX specific fuel temperatures
23 out of the approved Copernic code to get the right
24 initial conditions there.

25 DR. SIEBER: The delayed neutron fraction

1 is conservative for LOCA, but not for all --

2 MR. NESBIT: That's correct. I'm only
3 talking LOCA here.

4 We did a stylized comparison where we just
5 took the same conditions and ran it with the MOX and
6 then ran it next door with the LEU, and what we came
7 out with was a difference of less than 40 degrees in
8 terms of peak cladding temperature for this case.

9 The next slide shows the peak cladding
10 temperature plot versus time. As you can see, it's a
11 virtual overlay. In LOCA analysis space, this is the
12 same result.

13 DR. SIEBER: That's a calculated number.

14 MR. NESBIT: That is calculated.

15 DR. SIEBER: Does that take into account
16 particles? Particles run hotter than the surrounding.
17 So you're going to get a couple of degrees of
18 temperature.

19 MR. NESBIT: Well, the particles are in
20 the fuel pellet, and this is a cladding temperature.

21 DR. SIEBER: That's right, and the pellet
22 is right next to the clad. So if you heat up -- if
23 the pellets themselves are not homogeneous --

24 MR. NESBIT: That's right.

25 DR. SIEBER: -- then that will be

1 reflected in local spots on the clad.

2 MR. NESBIT: Well, I think you still get
3 a homogeneous temperature distribution within the
4 pellet, despite the fact that they're are very
5 localized. You know, we're talking micron distances
6 here. When you look at the profile across the
7 pellet --

8 DR. SIEBER: Fifty to 150 microns.

9 MR. NESBIT: -- most of the plutonium rich
10 particles are less than 50 microns in dimension. So,
11 you know when you talk about the actual pellet
12 temperature profile, despite the inhomogeneities on
13 the very micronic scale, on an overall scale the
14 temperature is going to be smooth.

15 DR. RANSOM: Certainly the average
16 temperature is what, about six inches to a foot that
17 you've averaged over the --

18 DR. SIEBER: Right.

19 DR. RANSOM: -- that's the node length and
20 the core?

21 DR. SIEBER: Yeah.

22 MR. NESBIT: Axially.

23 DR. RANSOM: So this has to be regarded as
24 an average behavior.

25 DR. SIEBER: That's right.

1 DR. RANSOM: Or could be.

2 DR. SIEBER: This is not a LOCA analysis.

3 DR. RANSOM: Right.

4 MR. NESBIT: We looked at the other
5 criteria in 10 CFR 5046 beside the peak cladding
6 temperature, and they were all met easily. The small
7 break LOCA is not a limiting transient for our plant,
8 and there's no impact of MOX on this anyway, and then
9 there's no impact of the MOX, adverse impact on the
10 LEU field because the hydraulics of the fuel are so
11 similar, the two field types.

12 In summary, we did specific evaluations
13 for the MOX assemblies and I'll remind you that mostly
14 the assembly programs don't do specific LOCA
15 calculations, but we did.

16 Analysis results are fundamentally
17 similar. We did sensitivity studies on plant
18 operating conditions, and these were used to establish
19 peaking criteria for our core designers to make sure
20 that the core designs keep the peaking below what's
21 required to meet the acceptance criteria.

22 Non-LOCA evaluations, I'm going to be real
23 fast here because I am about to exceed my time.

24 DR. POWERS: You're actually in pretty
25 good shape.

1 MR. NESBIT: The non-LOCA evaluations, we
2 looked at all of the Chapter 15 accidents. Most of
3 them are driven by things that are completely
4 insensitivity to the fuel pellet, global core, physics
5 parameters, system thermal hydraulics, stored energy.
6 Now that's affected by the pellet, but we use
7 generally bounding numbers that bound the core stored
8 energy there anyway, and decay heat.

9 We looked at some events in more detail
10 because they had the potential for localized effects
11 that could require further evaluation. We looked at
12 the control rod withdrawal or drop transient. We
13 looked at the steam line break transient. In both of
14 those cases typically the limiting assembly is a
15 rodded location, and we are not going to load the MOX
16 fuel in control rod locations for the first couple of
17 cycles. So there's no real impact there on the
18 overall accident analysis.

19 DR. SIEBER: But sooner or later you will

20 MR. NESBIT: Yes. When we got to batch,
21 we intend to load them in control rod locations.

22 DR. SIEBER: So you're going to address
23 this again.

24 MR. NESBIT: The guys that are doing those
25 analyses are currently performing those with the

1 assumption that the MOX will be in rodded locations.

2 DR. ROSEN: So what is the licensing
3 process when you go to batch? Do you come back?

4 MR. NESBIT: Yes, we'll come back to the
5 Nuclear Regulatory Commission with a license amendment
6 request for authorization to use Batch 1.

7 DR. ROSEN: And you get a reading on what
8 you saw here and when you used the lead test?

9 MR. NESBIT: We're listening as hard as we
10 can, yes, and we'll factor in what we hear here.
11 We'll factor in our experience with lead assembly
12 programs.

13 DR. ROSEN: Well, I'm more interested in
14 what you'll tell us when you come back about batch,
15 about what you saw in the plants rather than what you
16 heard here. That's the main thing.

17 MR. NESBIT: Yeah.

18 DR. ROSEN: With the pool-side inspections
19 and so on.

20 MR. NESBIT: The timing, our current plans
21 are such that we may not have the first cycle PIE back
22 by the time we come back with a batch license
23 amendment request. The NRC licensing process takes a
24 long time. We're living proof of that.

25 We can't wait until we have all of the

1 data from the PIE programs to turn in a batch license
2 amendment request because it will never get done.
3 What we anticipate is that that information will be
4 made available and will be factored in by the NRC
5 during their review.

6 DR. SIEBER: And I thought we were moving
7 at break neck speed.

8 MR. NESBIT: No comment.

9 (Laughter.)

10 DR. POWERS: The committee is, but we're
11 on the tail end of this process.

12 MR. NESBIT: Another thing we look at in
13 more detail is control rod ejection. Again, not
14 loading the fuel under a rodded location makes that
15 relatively benign. We actually did specific
16 calculations though for MOX in the core near a rodded
17 location, used 3D kinetics to eject the rod and see
18 what the power response is.

19 We got peak calorie per gram numbers that
20 were well below 100 calories per gram, which was the
21 conservative criterion that we chose to use.

22 Last, fuel assembly misloading is
23 something that's localized, but the same measures that
24 are in place for LEU fuel are equally effective for
25 MOX fuel in this area.

1 In summary, for most of the Chapter 15
2 accidents, four MOX lead assemblies clearly has a
3 negligible impact, and those with potential local
4 effects were evaluated in more detail, and they also
5 have no significant impact.

6 Radiological consequences, dose analyses,
7 if you will. First we did some scale analyses to see
8 the different inventories produced by MOX versus LEU.
9 Plutonium fissions have a different production or
10 different quantities, relative quantities, of fission
11 products, et cetera.

12 The most important one from a typical
13 Chapter 15 accident analysis is Iodine-131. For MOX
14 it can be as much as nine percent higher for a MOX
15 assembly than an LEU assembly, and this is the isotope
16 that drives a lot of off-site dose consequences.

17 DR. SIEBER: That's Iodine-131 in any
18 form, as opposed to gaseous form, a release form?

19 MR. NESBIT: Well, the dose calculations
20 we did address the form of the isotope, but this
21 calculation is purely how much is produced in the fuel
22 pellet of any form.

23 DR. SIEBER: In any form, right. Okay.
24 Because the release fraction is higher than nine
25 percent.

1 MR. NESBIT: Right, right. This is
2 just --

3 DR. SIEBER: May be double.

4 MR. NESBIT: What this means is that for
5 a MOX assembly at a given burn-up, you would have nine
6 percent more Iodine-131 produced than a uranium
7 assembly in the same burn-up, and actually it's less
8 than that for most cases. Nine percent is a bounding
9 number. It's a burn-up dependent quantity.

10 For accidents that involve a lot of fuel
11 assemblies failing, postulated accidents like LOCA,
12 like rod ejection, like locked rotor, the effects of
13 the MOX assemblies is essentially swamped by the
14 predominant failures in the LEU assemblies.

15 We looked at that and assessed it and
16 showed that in the application.

17 For actions that involved one or a few
18 assemblies, there's no dilution effect of LEU. So we
19 looked at those explicitly, and that's the fuel
20 handling accident and the weir gate drop for Catawba.

21 We performed calculations using the
22 alternate source term methodology, which is the
23 licensing base for Catawba for those particular
24 accidents, and we also did a sensitivity study by
25 increasing the Reg. Guide 1183 gap fractions by 50

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1 percent to account for the possibility the MOX
2 assemblies would have higher fission gas released.

3 As you might expect, the result of this 50
4 percent and that nine percent I talked about earlier
5 is to increase the amount of iodine that would reach
6 a receptor off site or in the control room, and
7 although the doses did go up, they're still well
8 within the regulatory limits, which is shown on the
9 next slide.

10 To summarize, there's a potential for
11 impact on calculated doses, and we talked about why.
12 We did explicit analyses of the ones that had the
13 greatest potential for an impact, and we did a
14 conservative treatment of the MOX LEU differences, and
15 we showed that the results are still well within
16 regulatory limits.

17 The last part of the presentation is about
18 the environmental evaluation. We submitted an
19 environmental report along with our license amendment
20 request to assess the potential impact of using four
21 lead assemblies on the environment. In normal
22 operations we found there's no impact on effluents and
23 there's a slight, very slight increase in fuel
24 handling occupational dose because the fresh MOX fuel
25 is slightly higher in dose than unirradiated uranium

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1 fuel, although the fact that it's weapons grade means
2 that it's much, much lower in dose than it would be if
3 it was reactor grade and had quantities, substantial
4 quantities of americium. So there's another example
5 of how weapons grade works to our benefit.

6 The accident analyses we've already talked
7 about. We looked at severe accidents as well because
8 that's one of the issues of discussion I guess I would
9 say related to MOX fuel.

10 In 1999, DOE did an environmental impact
11 statement on the use of batch quantities up to 40
12 percent cores of MOX fuel, and they did an evaluation
13 of that impact on several severe accident sequences
14 for McGuire, Catawba and North Anna.

15 We took those results, which were based on
16 the difference in the radionuclide inventories and
17 assuming that everything else about the severe
18 accident stayed the same, and scaled those results by
19 the amount of MOX fuel we were loading, four
20 assemblies versus 76, and the results of that scaled
21 analysis shows that the consequences for the DOE
22 analyses would change. Some of them would go down a
23 little bit. Some would go up a little bit. The
24 maximum change would be less than one percent.

25 Ed Lyman did an analysis which was

1 published in 2000 in which he did a similar analysis
2 for the use of batch quantities of MOX fuel. He used
3 different assumptions with respect to release
4 fractions, et cetera from a NUREG versus the IPE that
5 the DOE analyses were based on. He goes somewhat
6 higher impacts, but again, scaled the same way back to
7 four lead assemblies. The overall impact is about 1.6
8 percent maximum higher impact from before MOX fuel
9 lead assemblies, and that's assuming, as he did in his
10 sensitivity study, that there's a much higher overall
11 actinide release from the core.

12 In summary, we think that the severe
13 accident behavior is going to be driven by the LEU
14 field, which is a predominant fuel in the core. We
15 note that there's a lot of uncertainties when you're
16 calculating severe accident behavior in light water
17 reactors, to begin with, and to think you're going to
18 get it within one percent is kind of fooling
19 yourselves a little bit to start with.

20 CHAIRMAN BONACA: So what you're saying
21 here is that when you calculate your global core
22 physics parameter, you expect them to be mostly driven
23 by the LEU fuel?

24 MR. NESBIT: Absolutely they are. We did
25 that calculation, and they are.

1 CHAIRMAN BONACA: And so you inspect your
2 Doppler coefficient, moderator temperature coefficient
3 to be reasonably close to the LEU.

4 MR. NESBIT: That's correct, and in an
5 earlier slide, I actually showed that on a percentage
6 basis, and they were all within three percent.

7 CHAIRMAN BONACA: Well, that was only for
8 the lead.

9 MR. NESBIT: That was for lead assemblies.

10 CHAIRMAN BONACA: For the assemblies. I'm
11 asking about when you're going to go to a full batch
12 loading. What's the experience from the European
13 reactor?

14 I mean, we know already that they are
15 loading MOX fuel or some type of MOX fuel.

16 MR. NESBIT: Right.

17 CHAIRMAN BONACA: Are the characteristics
18 of the core pretty much driven still by the LEU fuel
19 or by the low batch?

20 MR. NESBIT: The characteristics change
21 somewhat in certain parameters, particularly the
22 effective delayed neutron fraction.

23 CHAIRMAN BONACA: That's right.

24 MR. NESBIT: The moderated temperature
25 coefficients get a little more negative.

1 CHAIRMAN BONACA: Yeah.

2 MR. NESBIT: The biggest impact is on the
3 delayed neutron fraction. Again, I didn't bring any
4 info on batch. We've done the analysis for batch, and
5 that was actually included in one of our REI
6 responses.

7 DR. POWERS: To be fair to you, you didn't
8 bring any because we explicitly instructed you not to.

9 MR. NESBIT: Well, that's true, and
10 occasionally I do listen to instructions, but the
11 impacts, Dr. Bonaca are not extreme, but in terms of
12 delayed neutron fraction, it's kind of interesting.
13 What you see is that the biggest at the beginning of
14 cycle, and at end of cycle there's a relatively small
15 impact because that's when all of the uranium fuel has
16 built up a lot of plutonium.

17 And, in fact, it actually makes the core
18 much more uniform in terms of physics characteristics
19 over the whole cycle to load MOX in.

20 To sum up on the severe accidents, we've
21 looked at some other things that people have done with
22 their reactors that have the potential to change
23 severe accident consequences like changing cycle
24 length, power up rates, et cetera, and as far as we
25 can tell, nobody has ever addressed in an

1 environmental report the change on severe accident
2 consequences.

3 But if you take a power up rate of 17
4 percent or so, which there has been one, that's a 17
5 percent change in severe accident consequences. We're
6 in the noise compared to things like that.

7 DR. RANSOM: Is the implication of this
8 that if you have an entire MOX core and you only get
9 1.6 percent increase in actinides from a two percent
10 MOX core, that an entire loading would be much
11 greater?

12 MR. NESBIT: Oh, yes. The actinide
13 concentrations go up substantially with MOX,
14 absolutely.

15 DR. RANSOM: Is there a reason for that?

16 MR. NESBIT: Well, you start higher on the
17 isotopic ladder, starting at 239 instead of 238, and
18 so you --

19 DR. RANSOM: It's just one.

20 MR. NESBIT: It's a big one. It's got
21 1,000 born cross-sections.

22 DR. RANSOM: So the particles that are
23 produced then, the actinides that are produced as a
24 result of that fission are --

25 DR. POWERS: I'm going to have to

1 interrupt because we're focusing on the LTAs here, and
2 to go into the full accident analysis gets us into a
3 range of great controversy right now.

4 MR. NESBIT: But it does make a
5 substantial difference on a per assembly basis if you
6 start with a substantial amount of plutonium in the
7 fuel assembly. You will get more actinides.

8 Let me rephrase that and then I will move
9 on. You will get substantially higher percentages of
10 the higher actinides, like americium and curium and
11 stuff. There are still very small amounts in an
12 overall basis, but relative to an LEU assembly, you'll
13 see a big percentage increase.

14 I went the wrong way, didn't I? That's
15 not where we need to go. I'm going to wrap up.

16 Big picture. I'm going to say this again
17 anyway. I just want to remind people --

18 DR. POWERS: You're just going to get Dr.
19 Apostolakis histrionic if you say that.

20 DR. APOSTOLAKIS: What was that?

21 MR. NESBIT: You woke him up.

22 DR. POWERS: He will tell you that this
23 has been labeled by at least one commissioner as a
24 canard.

25 MR. NESBIT: This is a canard. Let me

1 talk very briefly about my canard.

2 At Catawba at the end of cycle, we have
3 about 850 kilograms of plutonium in our reactor core,
4 and it's producing about half of the power. Now,
5 we're talking about loading four lead assemblies,
6 which will have about 80 kilograms of plutonium.

7 The point I'm trying to make here is this
8 is not some unprecedented perturbation and novel use
9 of plutonium we're using it now.

10 There has been a number of lead assembly
11 programs, most recently one at Ginna, and it's not all
12 that recent, but in the early 1980s, in which they
13 loaded four MOX fuel lead assemblies in a 121-fuel
14 assembly course. They had a higher core fraction of
15 MOX there with their program, and they had no reported
16 problems from that.

17 DR. SIEBER: That's B.C., before Carter?

18 MR. NESBIT: It's actually A.C., but not
19 too long after that.

20 European reactors have demonstrated safety
21 using mixed oxide fuel in higher quantities and for
22 decades. Again, what we're proposing to do and what
23 we're asking regulatory approval for is to use four
24 MOX assemblies out of 193 in our core.

25 DR. LEITCH: Just a question here. What

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1 we're requesting is four lead test assemblies in
2 either Catawba unit, not both, right?

3 DR. POWERS: The license application is
4 for either Catawba unit. Our plans are to insert them
5 in Catawba 1 in the spring of 2005.

6 DR. LEITCH: Now, I guess my question
7 really is: will that be completely transparent to the
8 operator or will there be different operating
9 procedures, emergency procedures, abnormal procedures
10 for the unit with the lead test assemblies versus the
11 unit without lead test assemblies?

12 MR. NESBIT: Well, we routinely update our
13 simulators to reflect the as built core configuration
14 characteristics. So it will be consistent there, but
15 from a realistic --

16 DR. LEITCH: That will be consistent with
17 one of the units, but the other unit --

18 MR. NESBIT: It's Catawba 1.

19 DR. LEITCH: Yeah, but there will still be
20 training going on for the other units which will be
21 different, if there was a difference.

22 MR. NESBIT: But in terms of what the
23 operator sees at the console, there is no difference.
24 Once you've got the assemblies loaded in the reactor,
25 the only difference you can see is when you do a flex

1 map, and you look at the in-core entrance. We do that
2 once a month, and the operators don't even do that.
3 The reactor engineers do it.

4 So from an operations perspective, it's
5 transparent. There are a number of plant preparations
6 we have to put into place and are putting into place
7 with respect to fuel receipt, handling, radiation
8 protection, et cetera. That work is ongoing.

9 But once the fuel is in the core, it's
10 transparent.

11 DR. ROSEN: Now, this is a request for
12 loading four MOX assemblies in either Catawba 1 or 2,
13 but not both?

14 MR. NESBIT: That's correct, either/or,
15 either but not both.

16 As you're certainly aware, there's some
17 intervenor issues that have been raised. In the
18 interest of time, I haven't tried to address those
19 issues on a point-by-point basis in this presentation.
20 I will note the contentions that have been admitted
21 outside of the security realm address the impact of
22 MOX and LEU differences on LOCA and severe accidents.

23 There's one related to the failure on our
24 part to fully evaluate the use of MOX fuel at Oconee
25 as an alternative, and then, of course, there's some

1 contentions related to security. We've addressed
2 these contentions in our filings with the Board and in
3 our license amendment request. There's hearings
4 scheduled in June for the non-security contentions,
5 and in September for the security contentions.

6 I think the fundamental issue at play is
7 how much alleged uncertainty is acceptable to go
8 forward with the lead assembly program. I will
9 absolutely say with no doubt in my mind that people
10 can ask questions faster than I can answer questions,
11 and what we have attempted to do is to show that for
12 this lead assembly program, the four fuel assemblies
13 out of 193, we've bounded the impacts to the safety
14 and health of the public, and they're acceptable.

15 I guess I'd also add my little commercial
16 here. I think we've done a lot of progress in the
17 last 20 years or so in the nuclear industry in terms
18 of fuel performance and fuel behavior, and a very
19 important part of that is the ability to conduct lead
20 assembly programs, lead test assembly programs at the
21 plants and verify that design changes are appropriate
22 and safe and beneficial and things like that.

23 And I'd hate to see a situation arise
24 where we're constrained on a lead assembly program by
25 a standard of perfect certainty that we know

1 everything that's going to happen because by
2 definition on a lead assembly program you're doing the
3 program to gather information whether of a
4 confirmatory nature or otherwise.

5 DR. APOSTOLAKIS: So the challenge is that
6 your calculations are not bounding, right? Is that
7 correct?

8 MR. NESBIT: I think they are.

9 DR. APOSTOLAKIS: No, I know that you
10 think they are, but they are challenging you on that.

11 MR. NESBIT: And they're not even saying
12 that they're wrong. They're saying that we haven't
13 proven sufficiently that they're right.

14 DR. APOSTOLAKIS: Okay.

15 MR. NESBIT: And I think that's the wrong
16 standard to apply to a lead assembly program.

17 The conclusion is what I've been saying
18 for the last 45 minutes or so. We've addressed the
19 impact of MOX fuel on normal ops, design basis
20 accidents, and we've even looked at severe accidents
21 and shown that we've met the regulatory limits, and
22 there's no significant hazard to the health and safety
23 of the public.

24 That concludes the presentation, and I've
25 had a lot of questions already. If there's any more

1 at this time, I'd be glad --

2 DR. ROSEN: Just one quick one on
3 characterizing the dose to the handles of new fuel.
4 You said it was going to be higher or different. Can
5 you do better than that?

6 MR. NESBIT: Yeah, I can. It's about 25
7 millirem per hour on contact. About half of that is
8 neutron and about half is gamma, whereas for a typical
9 LEU assembly you're less than five MR per hour on
10 contact, and we did a very bounding evaluation of what
11 that would mean for the entire receipt and inspection
12 procedure, and we came out with a total 42 person-
13 millirem for the four assemblies. We think that's
14 grossly conservative as well, but that's the kind
15 of --

16 DR. ROSEN: With the same inspection
17 standards and so on.

18 MR. NESBIT: Right, right. So that's the
19 kind of impacts we'd be looking at there.

20 DR. ROSEN: thank you.

21 DR. POWERS: If there are no other
22 questions, thank you, Mr. Nesbit.

23 I'll turn to the staff and Mr. Martin.

24 MR. MARTIN: Good morning. I'm Bob
25 Martin. I'm the NRR project manager for the review of

1 the use of mixed oxide fuel at Catawba.

2 We have with us today staff in the
3 principal areas of interest from Reactor Systems
4 Branch and from our folks doing the dose consequences
5 review.

6 The review also covered several other
7 areas, such as routine effluent releases, reactor
8 vessel materials, and quality assurance as discussed
9 in our safety evaluation.

10 The licensee's application was submitted
11 about 14 months ago, February 27, 2003. It has been
12 followed by numerous supplements from the licensee,
13 which are detailed in the safety evaluation. We
14 issued the safety evaluation on April 5th of this
15 year. In that safety evaluation the NRC staff found
16 the use of the MOX lead test assemblies to be
17 acceptable on the basis of the evaluations that are
18 included in to.

19 We made clear that the issuance of that
20 safety evaluation did not constitute the formal
21 licensing approval. Other things will take place,
22 including the issuance of the results of our
23 environmental evaluation and so forth.

24 A complicating issue which was mentioned
25 at the beginning of the meeting is that shortly after

1 the issuance of that safety evaluation we learned that
2 the licensee's plans for that core, which would
3 contain the MOX fuel assemblies, would also include
4 eight lead test assemblies of what is called a
5 Westinghouse next generation fuel design.

6 Sine that time a number of actions have
7 taken place. The licensee addressed the issue in a
8 letter dated April 16. We have met with the licensee
9 in a very brief meeting on April 23rd. We've taken a
10 tab at indicating our general areas of interest in
11 this subject in a letter that we just issued last
12 Friday.

13 We plan to communicate with the licensee
14 further until we understand this issue, and we'll
15 document that in a supplement to the safety
16 evaluation.

17 DR. SIEBER: A quick question. There is
18 a MOX fuel design report which was referenced in the
19 previous speaker's slides as VAW-10238. Is that part
20 of the application or is that a stand-alone?

21 I notice it has its own safety evaluation.

22 MR. MARTIN: It's a topical report similar
23 to quite a number of other topical reports that
24 support the application.

25 DR. SIEBER: So in order to review the

1 application, you have to review that, too?

2 MR. MARTIN: We reviewed that topical
3 report. That's a report on the Framatome MOX fuel
4 assembly design, and we reviewed that and produced a
5 safety evaluation on it.

6 DR. SIEBER: Right.

7 MR. MARTIN: There are some details that
8 need to be cleaned up as a result of the licensee's
9 comments on the safety evaluation which we produced,
10 and those will be taken care of in the near future.

11 DR. SIEBER: Okay.

12 DR. LEITCH: Are these other lead test
13 assemblies are scheduled for installation into Catawba
14 No. 1, not both units.

15 MR. MARTIN: The other lead test assembly?
16 The NGS, as we call them?

17 DR. LEITCH: Yeah.

18 MR. MARTIN: My understanding is they were
19 loaded into Catawba 1, cycle 15.

20 DR. LEITCH: Oh, they were already in
21 there.

22 MR. MARTIN: I believe they started up
23 last fall or early this year with them.

24 DR. LEITCH: Okay.

25 MR. MARTIN: In Cycle 15, which does not

1 include the MOX assemblies. Cycle 16 is the cycle
2 that Duke anticipates putting the MOX fuel assemblies
3 in.

4 DR. LEITCH: So if perchance the schedule
5 were to slip and MOX assemblies were going to go in
6 Unit 2, this would not be an issue, right?

7 MR. MARTIN: If the schedule slipped and
8 the core that Duke proposes to put the MOX assemblies
9 in is basically a Westinghouse robust fuel assembly
10 design, plus the four MOX lead test assemblies, then,
11 yes, that's the core design that we reviewed.

12 DR. LEITCH: Okay. Thanks.

13 MR. MARTIN: Okay. I think there is a
14 significance to the NGS with respect to Catawba Unit
15 1 in that it represents something that the staff has
16 not evaluated and was not reflected in our safety
17 evaluation. Whether when we get into that review --
18 we're in the midst of it now. As we continue it,
19 whether we have concerns about whether we should
20 approve it or not, I simply can't say today. We have
21 not progressed that far into the review.

22 So that completes my introductory
23 comments. If there are no further comments, I would
24 turn it over to Undine Shoop of our Reactor Systems
25 Branch staff, and she'll discuss Reactor Systems

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1 Branch's review.

2 MS. SHOOP: Good morning, gentlemen. I'm
3 here today to talk about the SRXB review that we
4 performed as part of this licensing application. As
5 we've alluded to previously, this will not touch in
6 any way upon the NGF fuel assemblies, lead test
7 assemblies, that are currently in the core. We are
8 only going to discuss the review that we performed
9 because that's all we're able to talk to today.

10 And I'm going to skip around. I'm not
11 actually sure. I've provided a lot of information in
12 the handout. I'm not sure there's actually time to go
13 through that many slides. So I may omit them, some of
14 the slides, but I did want to provide that information
15 to you. That way you have it as you are deliberating
16 this action.

17 The purpose for us to come here today is
18 to talk about the thermal mechanical design of the
19 fuel assembly, the data collection program that's
20 proposed by the licensee, the nuclear design, the non-
21 LOCA transient analysis, and then I'm actually going
22 to ask Ralph Landry to come up and talk about the
23 actual LOCA analysis that was performed.

24 And one of th things we always have to
25 discuss is what is the purpose of an LTA. To keep it

1 into perspective, what are we actually doing here?

2 Recognize that the purpose of an LTA is,
3 first and foremost, to collect data. That is the
4 number one reason that we use LTAs, because in order
5 for us to license something for batch loading, you
6 have to have data that shows that you can use it, and
7 what you say about it is actually behaving.

8 But the only way to collect data is to
9 allow a limited number of test assemblies, and that's
10 what this application is for. The purpose of it is to
11 collect data to support the behavior of MOX fuel.

12 And now I'm going to go into the thermal
13 mechanical design. As we've talked about, the fuel
14 assembly design, the lead test assemblies, was
15 licensed using SRP 4.2. SRP 4.2 was originally
16 developed for low enriched uranium fuel, but we do
17 believe that those parameters are equally important
18 for MOX fuel.

19 The design evaluation was provided in BAW-
20 1023, which is the MOX fuel design report, which Jack
21 has already alluded to. In that report, that provided
22 the analysis, the thermal mechanical design analysis
23 that we require for any new fuel product, and it
24 provided those parameters that were specific to MOX
25 fuel.

1 Because the parameters were specific to
2 MOX fuel, they labeled that fuel assembly the Mark
3 BW/MOX 1 fuel assembly design. It is the structural
4 equivalent of the Advanced Mark-BW design, but we do
5 differentiate them because they do have some slightly
6 different characteristics that they were approved for,
7 and we wanted to note those differences.

8 And I'm sure you guys have seen the SRP
9 enough times that I don't actually need to go into
10 what's in the SRP.

11 Just to give you a really slight touch on
12 what is the difference between the Advanced Mark-BW
13 fuel design, which is proposed for low enriched
14 uranium fuel and the Mark-BW MOX 1 fuel design, the
15 Mark-BW MOX 1 has a longer fuel rod which is to
16 accommodate the fission gas. It has the European dish
17 and chamfer design. What that is because is because
18 for these LTA assemblies, they're going to be produced
19 in Europe and the machines are already designed to
20 produce a certain dish and chamfer, and that's a basis
21 of the machine itself.

22 And actually using that machine, having
23 the dish and chamfer of the European design will
24 actually make the pellets more consistent with the
25 European experience.

1 They're also going to use a 95 percent
2 theoretical density. The Advanced Mark-BW is going to
3 use a 96 percent theoretical density. However the 95
4 percent is currently what everyone is using for MOX.
5 So there, again, the lower theoretical density, which
6 is consistent with current uranium theoretical density
7 is to be consistent with the uranium database.

8 And of course, the most specific is that
9 it uses MOX fuel instead of uranium.

10 DR. SIEBER: Now, do you expect these
11 characteristics of dish and chamfer and density to
12 remain the European standard when the process becomes
13 a full batch process in the United States or will we
14 adopt a dish and chamber that we use?

15 MS. SHOOP: That would actually be part of
16 an application for batch loading because we have -- I
17 should actually back up. One, oh, two, three eight
18 requested approval for both batch and LTA. We're
19 approving it for LTA only because we believe that the
20 information contained in there was more specific to
21 the LTA, and we have enough information to approve
22 LTA. The jury is kind of out on some of the things
23 for batch loading, and so that's the purpose of the
24 LTA, is to collect the data to be able to demonstrate
25 that it's good for batch.

1 At this point I can't really project out
2 what they'll do for batch because I do believe that
3 that is a decision that Framatome will be making as
4 they --

5 DR. SIEBER: But you are suggesting that
6 I would just wait and see.

7 MS. SHOOP: Yeah.

8 DR. SIEBER: Okay. Thank you.

9 CHAIRMAN BONACA: But since you're
10 collecting mechanical performance, if you change dish
11 and chamfer design, wouldn't that upset the results of
12 the lead test assemblies?

13 MS. SHOOP: Actually the dish and chamfer
14 primarily is just to take down the hourglassing of the
15 pellet, and so actually I don't believe that even --
16 because it's a very, very slight change, the European
17 to the U.S., anyway. And I do believe -- and
18 Framatome can correct me if I'm wrong -- but I do
19 believe that the dish and chamfer for the MOX is the
20 same one that they use over there for their uranium.

21 CHAIRMAN BONACA: Yeah, right.

22 MS. SHOOP: So it's everything that they
23 use.

24 MR. NESBIT: If I can interject, we plan
25 to keep it the same for batch.

1 DR. SIEBER: But the only purpose for that
2 is to keep it from chipping around the edge of the
3 pellet.

4 MS. SHOOP: Well, to keep it from chipping
5 and then that's for the chamfer, but the dish is
6 actually to reduce the hourglassing.

7 DR. SIEBER: Make it look like a cylinder
8 when it's --

9 MS. SHOOP: Yeah, which of course, you
10 know, reduces the stress on the cladding during
11 irradiation.

12 DR. SIEBER: Right.

13 MS. SHOOP: Okay. Mixed oxide fuel. You
14 know, it's depleted uranium matrix with weapons grade
15 plutonium fissile material. The significance, of
16 course, is that you have fewer absorber isotopes, and
17 you have increased fissile isotopes.

18 As Duke has already presented, what
19 they're doing between the MOX and the uranium fuel,
20 they're doing a reactivity equivalence because they
21 know that in order to be able to have this much
22 reactivity in this part of the core, you need this
23 much reactivity.

24 So then when they went back and calculated
25 what type of plutonium enrichment they would need in

1 order to get that equivalent reactivity.

2 Okay. One of the topics that has come up
3 a lot when you talk about weapons grade MOX fuel is
4 the use of gallium. Gallium primary is part of the
5 plutonium in order to stabilize the weapons grade
6 plutonium.

7 People have hypothesized that it has the
8 ability to migrate to the cladding and to embrittle
9 the cladding material. Because of this, DOE has
10 sponsored two tests which are being performed out in
11 the advanced test reactor in INEL, and they tested two
12 fuel compositions, one of which was treated to remove
13 some of the gallium, and that was removed to a 1.3 ppm
14 level, and then they used an untreated pellet which
15 was 2.97 ppm.

16 The irradiations have gone up to 40,000
17 gigawatt days per metric ton, and so far they have
18 shown that the gallium does not migrate at those
19 levels.

20 Duke has proposed using a 300 ppb limit,
21 which is much lower, and so we do not expect that that
22 will migrate to the cladding in any respect either.

23 We will get results from the ATR at 50,000
24 gigawatt days before the LTAs go in. Of course, if
25 there is any difference seen between the 40,000 to the

1 50,000, the staff will have to reevaluate that.

2 Okay. Now, I would like to quickly
3 discuss the data collection program. The purpose of
4 the data collection program is basically because these
5 are tests. You want to check both the neutronic and
6 the fuel behavior of the LTAs, and this information
7 will be information that they need to support a batch
8 loading application.

9 And basically this will be able to
10 demonstrate that the Casmos simulate suite of codes
11 (phonetic), as well as the Copernic code, is actually
12 predicting as we expect it to.

13 DR. ROSEN: I thought I heard him say that
14 we would not see the post irradiation examination
15 results before they came in with a batch.

16 MS. SHOOP: I've read that, too, which is
17 kind of interesting.

18 PARTICIPANT: Can you clarify that?

19 MR. NESBIT: The neutronic information is
20 gathered in real time. So when we take a flux map
21 we've got it. We've got the information.

22 When I say post radiation examination, I'm
23 referring to pool-side examinations. When the fuel
24 assembly has been discharged, you measure things like
25 corrosion levels, growth, et cetera, and then hot cell

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1 exams, when you actually cut open a fuel rod and look
2 inside of it. That's the kind of information that's
3 not going to be available immediately.

4 DR. POWERS: You can see, Steve, once
5 again it's the metallurgist that slow us down.

6 (Laughter.)

7 MS. SHOOP: Well, when we start talking
8 about the neutronic, as Steve has already told us, the
9 LTAs are going to be instrumented locations. Actually
10 all of them are, but Duke had previously committed
11 that at least two of them would be in instrumented
12 locations so that they could run the transversing in
13 cores and be able to get actual cycle specific
14 measurements on a monthly basis. And that would be
15 used to verify the Casmos simulate.

16 And that would be done both for the first
17 and second irradiation cycles.

18 Oh, and they're also going to be doing a
19 start-up physics test plan, and that plan conforms
20 with ANS 19.6, which is the PWR start-up physics test
21 program, and they have committed to continue using
22 that program throughout the use of the LTAs.

23 DR. ROSEN: So let me come back to this.
24 Now, how long do we end up waiting before we hear what
25 the pool side PIE is on the lead test assemblies after

1 the batch has been licensed, which is, I think, what
2 you're saying?

3 Is it a year, two years? I mean, has the
4 batch been operating for several years before we get
5 the PIEs from the LTA assemblies?

6 DR. SIEBER: They won't be here.

7 MS. SHOOP: The batch loading is 2000-and
8 something. Steve, when do you have that planned for?

9 MR. NESBIT: I think a best guess would be
10 2010 or thereabouts. You know, we're looking at
11 putting a batch application in next year, but that's
12 not, you know, an absolute guarantee to give plenty of
13 time.

14 So, I mean, by the time the NRC would get
15 around to acting on that application, there would be
16 a couple of cycles of complete assembly data I would
17 think.

18 DR. ROSEN: Let me see if I can restate
19 what you just said. We would have the results from
20 the PIE from the first lead test assemblies in 2010.

21 MS. SHOOP: No. Actually, Steve, there's
22 -- actually let me go over my PIEs first so that you
23 can understand what the PIEs are and how they all
24 interrelate because there's actually three different
25 types of PIE.

1 MR. NESBIT: The first will be available
2 in 2006.

3 MS. SHOOP: Yeah, the first pool side PIE
4 are performed between cycles, between the first and
5 second irradiation, between the second and third
6 irradiation. You actually take it out, and during
7 that time you would do visual inspections of the fuel
8 assembly and fuel rods. You would check the fuel
9 assembly group, fuel rod group, and fuel assembly bow
10 to make sure that all of those parameters are within
11 specs and it's operating as --

12 DR. ROSEN: And that's before the first
13 batch.

14 MS. SHOOP: Absolutely, absolutely.

15 DR. ROSEN: Maybe I'll let you go ahead
16 and maybe I'll get a sense of this better.

17 MS. SHOOP: Okay. Because then actually
18 after the assembly discharge, which they will be
19 discharging at least one assembly after the second
20 cycle of irradiation. You would then do measurements
21 on grid width, fuel rod oxide thickness, grid oxide
22 thickness, the RCCA guide force, the guide thimble
23 plug gauge, and the water channels which checks for
24 fuel rod bowing.

25 And so you would actually do that between

1 the second and third, and then actually after you take
2 the assemblies out, which Steve had already discussed,
3 we're going to be getting some after the second cycle,
4 some after the third cycle. You would perform hot
5 cell PIEs, and that's where we're going to send it
6 down to Oak Ridge. They do the rod puncture test to
7 check the fission gas. They do metallography,
8 serametography (phonetic), which is where they check
9 for oxide and hydrides, and they also check for the
10 structure of the plutonium amglomerates (phonetic)
11 after it had been irradiated. They check the cladding
12 mechanical test for ductility. They do burn-up
13 analysis, and they will also do the burn-up
14 distribution to see how the amglomerates change and
15 how that compares to the prediction.

16 So all of those tasks will be performed,
17 and we will have that information for --

18 DR. ROSEN: I don't doubt that for a
19 minute. I just am trying to understand the sequence
20 and time between when you get all of that information
21 and when the first batch goes in.

22 DR. POWERS: Steve, the difficulty we have
23 is one of time, and this doesn't relate to the LTA
24 approval. I mean, it's an issue you can pursue when
25 we get to the batch.

1 DR. ROSEN: Okay.

2 MS. SHOOP: Now, I would like to go on to
3 the nuclear design and just touch on that.

4 As Steve has already said, you have four
5 LTAs and 189 other fuel assemblies. Therefore you
6 have an insignificant impact on core-wide neutronic
7 behavior.

8 How are they actually doing this? Duke's
9 core design loading strategy is to use a checkerboard
10 pattern, put the LTAs in symmetric locations where
11 they can run the transversing in cores, put them in
12 unrodded locations, and also so that the LTAs are not
13 in a limiting location of the core, but they are in
14 prototypical. That way the data is consistent with
15 what we expect the behavior of MOX fuel in a Catawba
16 or in a standard PWR to be.

17 And now this is going to be a bit more
18 challenging because I have two different graphs here.
19 These are my core key physics parameters, and what
20 you'll really look for here is that Duke did core
21 sensitivity studies. They actually did a core of all
22 LEU and then they actually put the four MOX assemblies
23 in to actually see what the impact and actually ran it
24 through simulate Casmos, to investigate how the core
25 parameters that were really important would change.

1 The ones that you really want to note are
2 the critical boron concentration, the control rod
3 worse, the moderator coefficient, and the fuel
4 temperature coefficient.

5 And as you'll notice here, you don't see
6 a substantial change, but there really is an
7 insignificant impact on those core-wide parameters by
8 inserting four MOX assemblies into the reactor.

9 There are some assembly physics parameters
10 that are slightly different, one of which we've heard
11 previously is the reduced delayed neutrons. However,
12 that's why Duke is not putting these in rotted
13 locations. Therefore, for the LTAs this will also be
14 insignificant.

15 I'd now like to turn attention to the non-
16 LOCA transient for just a moment. First of all, I
17 would like to point out that this was a deterministic
18 licensing. Therefore, they were only required to do
19 Chapter 15 analysis. They were not required to go
20 into severe accidents in their accident analysis, non-
21 LOCA transient portion.

22 They used a normal reload process, which
23 has already been licensed and approved by the NRC, and
24 during that process, they would confirm that all the
25 physics parameters fall within the reference values

1 previously calculated.

2 And if you look at Table 30-1 of the
3 November 3 REI response, you can actually see the
4 table where they went over all of the transients, what
5 the parameters were that they were already analyzing
6 for, and what the impact of MOX would be, and
7 demonstrated that the impacts were already within
8 their current analysis.

9 Steve has already talked about some of the
10 ones that are most important. So I thought I would
11 actually just put up your favorite one, which is the
12 control rod ejection, and for the control rod
13 ejection, they're not putting it in a rodded location.
14 Therefore, the impact on this particular code with
15 four MOX LTAs will be that the peak LEU assembly
16 enthalpy is 54 calories per gram, and the peak MOX
17 assembly because the MOX isn't in a rodded location,
18 but the one that would be closest to it, the maximum
19 that the MOX will see is 30 calories per gram, which
20 is below any of the test values for any of the studies
21 that have been performed so far.

22 And that's all I have on the non-LOCA
23 transients. Do you guys have any questions before I
24 turn it over to my colleague, Ralph Landry, who will
25 go over the local analysis.

1 MR. LANDRY: Okay. My name is Ralph
2 Landry from the staff in the Reactor Systems Branch,
3 and I'd like to talk a little bit this morning about
4 the review we performed of the MOX LTA LOCA. Okay.
5 The slides that I've given out are basically the same
6 slides that I used with the subcommittee two weeks
7 ago.

8 However, I have added a couple of slides
9 to help clarify a couple of points, but I don't want
10 to spend ten minutes on ten slides. I know that
11 that's not quite possible. So I'm going to try to
12 move through these slides rather rapidly this morning.

13 In the staff review, we looked at two LOCA
14 analyses. This morning Steve Nesbit presented results
15 that Framatome performed of an Appendix K calculation
16 for the LTAs. Now, when staff did the review, we
17 looked at two analyses, the analysis of record and the
18 MOX LTA LOCA analysis.

19 The analysis of record was performed by
20 Westinghouse with the W Cobra track realistic large
21 break LOCA code. That was done when Catawba was due
22 in a transition from Framatome fuel and Mark-BW fuel
23 assemblies to the Westinghouse robust fuel assembly,
24 the RFA fuel.

25 The analysis included sensitivity studies

1 which looked at the effect of Mark-BW fuel on the RFA
2 fuel. That sensitivity study came back and said,
3 okay, with the pressure drop of the Mark-BW assembly,
4 this is going to be the effect on the RFA fuel.

5 The box assembly, the Mark-BW MOX 1 or
6 Advanced Mark-BW whatever exact name is being used,
7 the assembly has a pressure drop that is much closer
8 to the pressure drop of the Westinghouse RFA assembly
9 than it is to the Mark-BW assembly that was resident
10 at the time of the transition to RFA fuel so that the
11 effect of the Mark-BW MOX 1 assembly on the RFA peak
12 cladding temperature would be less than the effect of
13 the at that time resident Mark-BW assembly.

14 Now, the Mox LTA LOCA response, as you
15 heard from Steve this morning was calculated using the
16 Framatome ANP Appendix K code RELAP 5 Mod 2-BNW. This
17 is an approved model. The approved code also includes
18 the property of the M5 cladding.

19 The one question that the staff had during
20 the review, or the more significant question, I
21 believe, was on the decay heat model that was used.
22 I've included a curve which you can't read on the
23 slide. So I added an extra slide with a large blow-up
24 of the decay heat curve.

25 The decay heat curve that was used by

1 Framatome for the MOX analysis is actually taking the
2 1994 decay heat curve which is predominantly a curve
3 for fission of plutonium, adding in the actinides,
4 applying that curve by 1.2. This is taking the 95th
5 percentile decay heat curve, increasing it by 20
6 percent to 1.2 times the 94 curve, which then ends up
7 bounding the 1971 curve multiplied by 1.2.

8 So the curve that was used for decay heat
9 by Framatome not only bounds the 95th percentile 94
10 curve by 1.2, but bounds the Appendix K specified 71
11 curve when it is multiplied by 1.2 also.

12 So this is a very conservative decay heat
13 curve.

14 DR. SIEBER: The rule tells you what curve
15 to use.

16 MR. LANDRY: The rule tells you to use 71
17 times 1.2.

18 DR. SIEBER: And what you're saying is
19 they didn't, but they bounded it.

20 MR. LANDRY: They used a curve that bounds
21 that, that is even more conservative than the rule
22 specifies.

23 DR. SIEBER: Thanks.

24 MR. LANDRY: This is because these
25 assemblies are MOX plutonium assemblies going into the

1 core. So we agreed with the analysis that was
2 submitted that using a curve that is more appropriate
3 to plutonium and then increasing with a factor of 1.2
4 meets the intent of the rule and is conservative.

5 Now, the results, let me skip up to
6 another slide I added from the subcommittee
7 discussion. To try to clarify the results and put
8 these into perspective, what I've given is the fuel
9 assembly type, what the pellets are that are loaded in
10 that fuel assembly and the computer code that was used
11 for the analysis.

12 The analysis of record performed for the
13 RFA fuel, which is low enriched uranium with a
14 realistic LOCA model is also a peak clad temperature
15 of 2,056 degrees Fahrenheit and a total maximum LOCA
16 oxidation level of ten percent.

17 The model that was used by Framatome for
18 the MOX LTA is using the Mark-BW MOX 1 assembly model
19 with MOX loading, and the Appendix K analysis
20 methodology results in a peak cladding temperature of
21 2,018 degrees for the MOX hot rod and a total maximum
22 LOCA oxidation level of four and a half percent.

23 As Steve said this morning --

24 CHAIRMAN BONACA: These are Appendix K
25 calculations.

1 MR. LANDRY: These are Appendix K. That's
2 what I'm trying to make clear here.

3 CHAIRMAN BONACA: Yeah.

4 MR. LANDRY: These are Appendix K. This
5 is realistic. This is the 95-95 value of PCT. When
6 the MOX 1 assembly is fueled with low enriched uranium
7 instead of MOX, everything else is the same about the
8 assembly. We then end up with a peak cladding
9 temperature of 1,981 degrees and a maximum local
10 oxidation of four percent.

11 This shows the effect of comparing MOX
12 with LEU at the non-limiting position in the core.
13 Now, we have to keep in mind that the reason these are
14 less using an Appendix K model is this is at the non-
15 limiting location, a more restricted peaking factor
16 than is used in the analysis of record value.

17 CHAIRMAN BONACA: What about the LEU to
18 the right? Is it also? I mean is that the limiting
19 location in the core?

20 MR. LANDRY: No, this is the non-limiting.
21 This is the same location as the MOX.

22 CHAIRMAN BONACA: Okay, all right. What
23 this ends up with, this ends up with a peaking factor
24 of 2.5 total, and I believe these come up with a total
25 peaking factor on the order of 2.4. It ends up about

1 four percent lower total peaking factor.

2 So on that basis the staff concludes that
3 the MOX LTAs will comply with the requirements of 10
4 CFR 5046 when inserted into a core of Westinghouse RFA
5 LEU fuel.

6 Now, there have been questions raised
7 about the effect of the MexGen fuel, and as has been
8 said, we are looking into that effect, and we will be
9 visiting Duke next week to look at all of the
10 calculations which they have to assure ourselves that
11 this effect is not going to influence the MOX.

12 But we have already heard Steve explain
13 that the MOX and the NGF fuel assemblies will not be
14 in a position where they will be adjacent. They will
15 not be in a position where they are in a direct line.
16 As he showed you this morning, there may be a MOX
17 assembly. There will be two RFA assemblies and then
18 the NGF assembly offset from that so that none of
19 these assemblies will even be in a direct line with
20 each other.

21 CHAIRMAN BONACA: The question that I have
22 is that you showed us three cases. One is a best
23 estimate and two are Appendix K in the no limiting
24 location. Did they use the same decay heat curve you
25 presented us before for all three cases?

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1 MR. LANDRY: No.

2 CHAIRMAN BONACA: No?

3 MR. LANDRY: But for these two, yes.

4 CHAIRMAN BONACA: Yes.

5 MR. LANDRY: The Westinghouse analysis is
6 using the W Cobra track uses a 95th percentile decay
7 heat curve. So this is a 95th percentile curve raised
8 by 20 percent from the Framatome analysis.

9 So that's why I put this chart together.
10 When we went to the subcommittee this caused a lot of
11 confusion trying to explain these different cases
12 because we're missing apples and oranges, and then
13 applies and pineapples.

14 So what I tried to do is put together the
15 different analyses that have been performed. So it
16 tries to make it inscrutable as much as possible what
17 has been done and why the staff concludes that the MOX
18 LTAs will not affect the analysis of record.

19 DR. SIEBER: You'd better quit while
20 you're ahead.

21 (Laughter.)

22 DR. POWERS: Are there any further
23 questions?

24 (No response.)

25 DR. POWERS: Mr. Martin, are you

1 continuing on to discuss any of the source term
2 analysis?

3 MR. MARTIN: If the committee wishes, yes.

4 DR. POWERS: Please.

5 MR. LaVIE: I apologize. The agenda
6 didn't have me speaking. So I'm going to be winging
7 this from what I remember from what I did at the
8 subcommittee meeting.

9 In reviewing the consequences of putting
10 the four LTAs into the LEU core, the staff considered
11 three main aspects of the use of the MOX fuel. First
12 was the increase in the core inventory and the
13 possible shift in isotopes due to the MOX having
14 fissile material of plutonium rather than U-235.

15 The second aspect was the potential
16 increase in the gap fractions. The open literature,
17 of course, discusses the fact that there is, because
18 of the higher temperatures in the MOX pellet compared
19 to an LEU pellet, there would be a higher diffusion of
20 gases. So the staff wanted to consider that.

21 Associated with that higher diffusion of
22 gases would be the rod pressurization which would have
23 an impact on the fuel handling accident.

24 As you may be aware, we allow licensees to
25 credit for removal of iodine from the gas being

1 released from the drop fuel assembly at the bottom of
2 the pool. The rod pressurization would have an impact
3 on that credit for decontamination.

4 In order to resolve these issues, the
5 staff looking for the source term, looked at some work
6 done by Sandia Labs on MOX fuel and also the
7 licensee's effort.

8 The staff also ran their own scale
9 calculation runs to develop their own source term.
10 The primary reason the staff did this is that the
11 licensee had run his calculations to maximize the
12 amount of Iodine-131, a conservative approach for the
13 scaling analysis.

14 The staff, however, was interested to see
15 whether or not other nuclides might rise to concern.
16 So the staff did the source term calculation for all
17 three cycles, picking the maximum concentration for
18 any isotope regardless of which cycle it fell in.

19 Our work confirmed the work by the
20 licensee. Actually our fraction turned up slightly
21 higher -- excuse me -- slightly lower, the ratio.
22 With that in mind, that satisfied the source term
23 issues first.

24 With regard to uncertainty in that, I'd
25 like to point out that the scale code module we used

1 in that was the SAS 2H module. This is a code module
2 that calculates based on the user's inputs the cross-
3 sectional libraries that would be used by the origin
4 model to generate the actual source term.

5 This is particularly advantageous because
6 it allows the licensee to do the same thing. It
7 allows the licensee and the staff to actually model
8 the fuel isotopics, various ratios of plutonium and
9 the actual fuel configuration in doing the
10 calculation.

11 We then had a look at the gap fractions.
12 As the licensee pointed out, they assumed a 50 percent
13 increase over that previously documented in staff
14 guidance.

15 Well, the staff felt that the 50 percent
16 was probably adequately conservative. There really
17 was no -- the 50 percent number was largely arbitrary,
18 and we wanted to go after and find out and make sure
19 that that was adequate. We requested the research
20 folks to perform some work for us, and they contracted
21 with the PNNL to run a series of FRAPCON code runs to
22 evaluate the fission gas release.

23 The FRAPCON code had been modified with
24 the conductivity correlations for MOX fuel as part of
25 the revision to 3.2 of the code. The licensee

1 provided as their projected power history, which was
2 also inputted into the code along with some
3 proprietary fuel parameters.

4 The result of that effort, PNNL generated
5 gap fractions that indicated that the licensee's 50
6 percent assumption was bounding for what we actually
7 saw in the data. In addition, they also showed that
8 the rod pressurization was below the threshold for our
9 assumption.

10 Our assumption of a decontamination factor
11 of 200 is based on a rod pressurization of less than
12 1,200 psig. They were able to show that.

13 With that done, we then were able to plug
14 that information into the calculations. Since the
15 fuel handling accident involved a single LEU assembly,
16 we looked at that one and did a confirmatory
17 calculation, confirming the licensee's conclusions
18 that that would not be inimical to the public health
19 and safety.

20 The licensee did a scaling approach for
21 the lock rotor accident, the LOCA analysis, and the
22 rod ejection accident. We felt that the scaling
23 analysis was appropriate given the small fraction of
24 LTAs in the core versus the amount of LEU fuel
25 involved.

1 For example, in the LOCA we assume all 193
2 assemblies are affected by the core melt. The LTAs
3 only represent 2.1 percent of that. Since we had
4 confirmed their ratio of a nine percent increase in
5 inventory and also the 50 percent gap fraction
6 increase, we were able to confirm their scaling.

7 We did consider the possibility that some
8 of the other nuclides may have had an impact, and we
9 looked at the noble gases because some of the noble
10 gases had increased substantially between the MOX and
11 the LEU.

12 However, when we did this, when we
13 conducted a scaling analysis for the impact on the
14 whole body dose, we found it was inconsequential and
15 that the licensee's assumption that the iodine dose
16 would be a good surrogate was valid.

17 We do not analyze ground contamination or
18 ingestion pathway in design basis analyses. So the
19 nuclides that have the biggest impact on that plume
20 exposure period is the noble gases and the iodines.

21 Based on our review of the licensee's
22 efforts, the staff was able to conclude that putting
23 the MOX LTAs in the core would continue to meet our
24 regulatory requirements for design basis accidents.

25 DR. POWERS: Thank you.

1 Now we have some words from Mr. Lyman with
2 the Union of Concerned Scientists.

3 MR. MARTIN: While Dr. Lyman is coming up,
4 there's one other thing that I should have mentioned,
5 and that is with respect to physical security plan,
6 both the licensee and the staff have recognized the
7 need to enhance the physical security plan for the
8 time of proceed of MOX fuel assemblies. That's a part
9 of our review. We understood the committee had not
10 planned to go into that area.

11 We did issue a supplement to our safety
12 evaluation yesterday addressing our finding on that.

13 DR. POWERS: Thank you.

14 DR. LYMAN: Well, once again, I appreciate
15 the opportunity to come to this committee and talk
16 about MOX fuel and my favorite subject.

17 I'm with the Union of Concerned
18 Scientists, and we're assisting the Blue Ridge
19 Environmental Defense League, or BREDL, in its
20 challenge of Duke's LTA license amendment request and
21 the associated security exemption request.

22 We submitted both security related
23 contentions, which have been argued so far in a closed
24 proceeding because of the safeguards information they
25 contain, and also a number of non-security related

1 contentions involving the safety environmental issues.

2 The outcome is that the board has accepted
3 one security related contention and certified another
4 which is now before the Commission, and it also
5 accepted three safety and environmental contentions by
6 consolidating and rearranging some of BREDL's original
7 contentions, classifying them in a very logical way.

8 Now, one point I'd just like to make is
9 that the process is being driven by Duke's request,
10 which stems from the Department of Energy's request
11 that this amendment be granted before the Department
12 of Energy ships plutonium to France for fabrication of
13 the lead test assemblies, and that is simply an
14 administrative request. There's no technical reason
15 why that approval has to be granted by August, which
16 is the projected date for shipment, but that's what's
17 driving the time table, and the Atomic Safety and
18 Licensing Board is attempting to accommodate that
19 request, and the result is a very highly compressed,
20 adjudicatory proceeding where we're all rushing at
21 breakneck speed.

22 So Duke may be complaining about the pace
23 of certain things. They shouldn't have any problem
24 with the pace of this proceeding.

25 DR. APOSTOLAKIS: Just for information,

1 you said before the plant shuts down. That's the
2 French plant, right?

3 DR. SIEBER: The Cadarache.

4 DR. LYMAN: I didn't want to get into
5 that, but the Cadarache plant is the older MOX fuel
6 fabrication plant in France, and it's not seismically
7 qualified. It actually was shut down last year, but
8 they are keeping it alive partly due to this one last
9 mission, which is fabricate the MOX LTA --

10 DR. APOSTOLAKIS: And if they don't do it
11 there, is there another place where they can do it?

12 DR. LYMAN: Yeah. I mean, the Melox plant
13 is the newer plant that the fuel rods are actually
14 going to be shipped to Melox after they've been
15 fabricated for assembly and the actual assemblies, but
16 there's a time limit.

17 I believe that the licensing approval
18 would be necessary to process weapons grade plutonium
19 in Melox when provided would have been a burden to the
20 current operation of that facility, and so the
21 preference was to do it in Cadarache so that you
22 wouldn't have any other mission, and they have also
23 fabricated breeder fuel in the past.

24 If I'm wrong about that, someone correct
25 me.

1 DR. SIEBER: Cadarache makes the rods,
2 right?

3 DR. LYMAN: Right.

4 DR. SIEBER: Up to the rod.

5 DR. LYMAN: Right.

6 DR. SIEBER: So what you're shipping is
7 rods.

8 DR. LYMAN: And then it will be shipped to
9 Melox.

10 DR. SIEBER: Right.

11 DR. LYMAN: For packaging and sending.

12 Now, my version of the big picture is only
13 a few points, but I think it has come up several
14 times, but any issues that are resolved in this
15 proceeding by virtue of the small number of LTAs in
16 the core are going to have to be reconsidered when the
17 application is received next year.

18 DR. SIEBER: Right.

19 DR. LYMAN: And although Duke made it seem
20 as if even the batch loading isn't going to be much of
21 a problem, obviously there are many serious issues
22 which will require a much more careful evaluation when
23 we come to that, including rod ejection accidents,
24 when it's going to be impossible to avoid rodding
25 certain MOX assemblies.

1 So in our view, all of these issues should
2 have been worked or at least could have been started
3 to be reviewed years ago when the NRC knew that this
4 process was in the pipeline. It seems like waiting
5 again for the next application before taking on the
6 hard issues is only going to increase the potential
7 for further delays. So we don't see why we shouldn't
8 start talking about those at this point, and this
9 amendment process provides an opportunity to do that.

10 Another issue which I'm personally
11 concerned about is that the U.S. approval process is
12 supposed to be setting an example for the Russian
13 counterpart. We know that this entire program is
14 focused on getting rid of Russian plutonium and the
15 U.S. symmetrical attempt to do it in a bilateral way,
16 but really focuses on Russia.

17 NRC is training Russian regulators in how
18 to license the MOX program, and we are setting an
19 example, and I think that it's in everyone's interest
20 to make sure that the Russian regulator doesn't cut
21 any corners and considers all safety and security
22 issues adequately in their own review.

23 And so for these reasons, I think a
24 thorough review should take place now.

25 I'm going to briefly touch on the security

1 exemption, which I haven't discussed yet, but I
2 thought in my view it's at least as important as the
3 safety issues, and the rationale for Duke seeking an
4 exemption from some of the Part 73, 45, and 46
5 security regulations are that they are, quote,
6 impractical and unnecessary to assure the security of
7 any MOX fuel assemblies, unquote. That's from their
8 non-safeguards cover letter, that original request for
9 the security exemption.

10 The sections, if you look them up, pertain
11 to the physical protection systems for protecting
12 Category I quantities and strategic special nuclear
13 material, which these MOX assemblies are since each
14 assembly will contain many times the formal quantity
15 on consignment from the design basis threat to
16 sabotage, and the details are mostly safeguards
17 information so that we're not going to talk about
18 them.

19 But Duke has gone on the record and appear
20 in the press that its basic position is that because
21 it's hard to divert plutonium containing bulky fuel
22 rods, that that's really the basis for why it believes
23 the Category I physical protection requirements are
24 unnecessary in these cases.

25 NRC provided its own guidance in the memo,

1 which I urge you to look at, from Joseph Shay
2 (phonetic) and Clem Tracey (phonetic), January 29th,
3 2004, which provided NRC's plan for how it's going to
4 approve the security exemption, and again, it seems
5 tha the staff's view is already quite close to Duke's,
6 and a MOX fuel assembly somehow much less attractive
7 to terrorists or adversaries because they're large,
8 heavy assemblies, and I'm not going to go into this.
9 It's in my handouts, but we are contesting really the
10 notion that there's something intrinsic about MOX fuel
11 assemblies that makes them less attractive or less
12 vulnerable to certain types of terrorist attack than
13 separated plutonium.

14 And there's also inconsistency with
15 international guidance, and I would urge you to look
16 at my written material.

17 Now, to get into the safety issues, our
18 contention one, which is reframed by the board,
19 focuses on LOCA and other design basis accidents, and
20 the contention is that Duke has failed to adequately
21 account for differences in MOX and LEU fuel behavior
22 with regard to design basis LOCAs and other design
23 basis accidents.

24 BREDL actually is concentrating on the
25 loss of coolant accidents. In our view, the other

1 design basis accidents are not as significant in our
2 view, and so our focus is on design basis LOCAs in
3 this case, and the issues involve fuel related
4 phenomena that may affect compliance with the
5 emergency core cooling system criteria for the MOX
6 LTAs that have not been adequately accounted by Duke's
7 application or the staff's review.

8 And also M5 cladding related phenomena
9 that may also affect compliance, in particular, from
10 the MOX test centers, and we can also look at the fuel
11 cladding interactions in a synergy between them in
12 considering the impact on the loss of coolant
13 accidents.

14 The fundamental problem is that the
15 experimental database for the behavior of MOX fuel
16 under LOCA conditions is very spotty. There are great
17 uncertainties, and in fact, the French Independent
18 Safety Agency, IRSN, came to NRC a few months ago with
19 a proposal for a series of tests at the reactor,
20 including a design basis LOCA test for MOX fuel to
21 reduce some of these uncertainties.

22 To go into some of the issues that IRSN
23 highlighted, one of the most important appears to be
24 fuel relocation during a design basis LOCA, and this
25 is during the clad ballooning phase, the collapse of

1 the pellic column into a rubble bed, which can have an
2 impact on ECCS compliance, such as the peak cladding
3 temperature and the local oxidation responding to that
4 temperature.

5 Fuel relocation is not considered an
6 Appendix K, and it's now regarded as one of the non-
7 conservatisms in independence K, but NRC's position is
8 it's balanced by the conservatism for independence K.
9 So it still may not be worth worrying about, but there
10 seems to be some internal issues with the staff,
11 whether or not fuel relocation is a significant
12 impact.

13 According to IRSN, it certainly looks like
14 it could have a significant impact. If you consider
15 fuel relocation, it could lead to an increase in the
16 peak cladding temperature by anywhere from 30 degrees
17 Celsius to 180 degrees Celsius depending on the
18 filling ratio, and that is how densely packed that
19 rubble bed is after the collapse, which increases the
20 local decay heat.

21 That increase in peak cladding temperature
22 can increase the local clad oxidation by up to ten
23 percent.

24 Now, relocation is not considered now for
25 either LEU or MOX, but to the extent that the margins

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1 to the ECCS criteria are smaller for MOX fuel, taking
2 relocation may be more important because of the
3 reduced conservatism with MOX. There's a small margin
4 of MOX to the peak cladding temperature limits. We
5 saw that in a previous slide. If you replaced an LEU
6 assembly with a MOX assembly at the same location,
7 you're going to end up with a somewhat higher
8 temperature, a peak cladding temperature.

9 Also, M5 cladding because it's more
10 ductile, it forms bigger balloons. The bigger the
11 balloon, the more opportunity and space there is for
12 relocation, and that's considered to be an important
13 time than on the likelihood of relocation and its
14 consequences.

15 DR. POWERS: Ed, could I ask you a
16 question about that ballooning used? Is that a
17 conjecture or do we have data on the ballooning of MOX
18 fuels?

19 DR. LYMAN: Well, this is strictly a
20 cladding related issued, and so it's just a matter of
21 fact at higher burn-ups M5 is more ductile so that it
22 is more plastic. It gets drained and doesn't rupture
23 or blows up to a larger balloon that will rupture.

24 I'm not sure I have much experimental
25 data, operating with cladding.

1 DR. POWERS: I understand. Thank you.

2 DR. LYMAN: Now, an issue which I raised
3 a few weeks ago and there seems to be some uncertainty
4 is the impact of the MOX fragmentation behavior on the
5 filling ratio. The filling ratio is very important,
6 as we see from this range between 30 and 180 degrees
7 Celsius based on IRSN calculations which have been
8 available to us during our discovery phase of the
9 proceeding.

10 And it's not clear whether, in fact, a
11 different micro structure in LEU will have an impact
12 on the filling ratio and in which direction. In
13 general, my intuition would be that to the extent that
14 the plutonium agglomerates and MOX fuel achieve higher
15 level burn-ups than occur in LEU fuel, so for the same
16 average fuel burn-up you have these regions of high
17 burn-up. I mean, if they start looking like high
18 burn-up LEU fuel sooner than LEU fuel does and develop
19 a core structured with fission gas, that in an
20 energetic event like a LOCA where there is a rapid
21 heat-up, if that causes fragmentation of the clusters,
22 it might lead to more fine fragments.

23 And I know, again, there's some issue
24 about what will happen. I went back and I looked at
25 the PIRT that NRC conducted in 2001 on LOCAs. That's

1 the phenomena identification ranking tables process,
2 expert elicitation on LOCA, and the expert panel was
3 not sure. They had some disagreement of what
4 direction this would be in, whether it would be
5 important, but clearly there was some concern that MOX
6 fragmentation was going to be different than LEU, and
7 that could have a different and potentially worse
8 impact if relocation specific.

9 And so the issue was really when you're
10 talking about helium burn upset is 45 to 50 gigawatt
11 days per ton, the LEU fuel may not experience the most
12 severe high burn-up effects that MOX met.

13 Another issue that has to do with the
14 interaction between the fuel is that the bonding
15 apparently is another very important issue in
16 relocation. Obviously if there's a greater bonding,
17 it might help to pull the fuel apart during the
18 ballooning process, but again, it seems that this is
19 an area of uncertainty, and this is why IRSN thinks
20 that integral tests on actual high burn-up fuel is
21 warranted.

22 Just to show, if you look at the Appendix
23 K calculation, it doesn't consider relocation effects.
24 We see that the simple substitution was one of the
25 MOX assemblies for LEU assembly in the same position,

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1 leads to a somewhat higher temperature, looking at an
2 average increase of 105 degrees Celsius, which is just
3 the average of that range I showed you, would bring
4 the MOX PCT well over the regulatory limit of 2,200
5 degrees Fahrenheit and also have an impact on LEU, but
6 to the extent the large and small MOX, we have to
7 worry about it more if we're going to ignore and say
8 that MOX is okay.

9 Now, M5 cladding issues, although M5 was
10 approved by the staff back in 2000, it seems that
11 there are still some technical issues associated with
12 MOX, with M5 cladding, both LEU and for MOX. Right
13 now Research is trying to obtain high burn-up fuel
14 with Zircaloy M5 cladding as part of its cooperative
15 agreement with EPRI, and from the tone, it looks to me
16 like they're not having success in obtaining the
17 samples yet.

18 A letter was sent April 21st, 2004, from
19 Research to EPRI, again, urging EPRI's cooperation to
20 provide these samples of irradiated fuel, and this
21 letter points out that parallel testing at Argonne in
22 unirradiated Zircaloy M5 cladding has shown
23 significant differences in Zircaloy.

24 And this could have something to do with
25 tests that are done at Argonne to try to understand

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1 the differences between Alloy E110, which has
2 nominally the same metallic composition as M5
3 cladding, but yet has considerably different
4 observation behavior and poor performance in design
5 basis LOCA conditions.

6 Apparently Argonne did some tests on M5
7 samples by etching them, which is not the current
8 preparation for M5, but then found that that led to a
9 potential similarity to the outside characteristics of
10 Alloy E10, and this raises questions regarding M5 with
11 respect to the changes that might occur during
12 radiation, and this, again, is why Argonne agreed to
13 seeking these samples for testing and not receiving
14 them yet.

15 But I don't think the M5 cladding issues
16 are going to go away, and to the extent that there are
17 interactions between M5 and MOX that might pose a
18 problem, that's a concern.

19 I'd also like to point out that Mr. Nesbit
20 did mention that in a previous subcommittee meeting
21 that out of all of the MOX fuel assemblies irradiated
22 in Europe, in France, in particular, virtually none of
23 them used M5 cladding. Only a couple of experimental
24 assemblies so far were MOX fueled; M5 cladding was
25 preserved. So there's very little radiation

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1 experience with MOX cladding.

2 Moving right along, contention two related
3 to source term issues and alleges that Duke is not
4 adequately accounting for differences in MOX and LEU
5 fuel behavior with respect to cladding releases during
6 four disruptive accidents which the board has defined
7 to include both design basis accidents like the Part
8 100 type event and also beyond design basis severe
9 accidents.

10 To this end, there are suggestions from
11 the limited amount of testing that's been done with
12 MOX fuel in Europe that there are different
13 radionuclide release characteristics of MOX fuel
14 compared to LEU. These have not been taken into
15 account by Duke's analysis or the staff's review.

16 In particular, because of the MOX
17 microstructure, not only is there a greater fission
18 gas release to the gap during normal operations, but
19 under LOCA or severe accident conditions, there appear
20 to be enhanced release rates with some radionuclides
21 from MOX and go to LEU, presumably because of the
22 different matrix structure, and degradation behavior
23 of MOX fuel in severe accidents may be different than
24 the different timing during the core slumps, and any
25 of these things could affect source term and

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1 consequence analysis.

2 Also, current source terms apparently
3 underestimate tellurium and ruthenium isotope release
4 patterns, and these are two other categories in
5 addition to iodine, in which actinides could have
6 substantially greater in MOX fuel. So to the extent
7 that the source term doesn't use realistic release
8 fractions with tellurium and ruthenium, it means we
9 are not fully accounting for the differences in
10 inventory very sensitive to MOX fuel characteristics.

11 So, again, there are uncertainties due to
12 gaps and experimental database for MOX under core melt
13 conditions. IRSN has proposed a MOX source term test
14 for severe accidents again for THADE-related events.
15 We believe those tests are also warranted.

16 So in conclusion, we still think there's
17 a lot of research needed to reduce the uncertainties
18 in M5 cladding and MOX fuel performance during LOCAs
19 and severe accidents. There are a series of tests
20 that are proposed or in the works, but if Argonne does
21 get irradiated M5 clad LEU fuel to run LOCA, that will
22 provide some information.

23 Walden is in the midst of preparing for
24 and may have even begun a fuel relocation test on high
25 burn-up LEU fuel, and again, under the proposed tests,

1 which are, as far as I know, not financed yet, and NRC
2 didn't show much interest in providing assistance at
3 the meeting that I attended in October.

4 Again, some more uncertainties introduced
5 by this latest indication that Duke is going to be
6 loading another type of experimental fuel at the same
7 time the MOX LTAs are. I haven't had time to assess
8 that.

9 So in sum, we just don't think the
10 experimental database is sufficient to support
11 approval of the LTA power out at this time unless we
12 can start to close some of the gaps, especially for
13 performance of MOX fuel during design based LOCA.

14 Now, as far as risk calculations go, we
15 don't think Duke has demonstrated adequately that the
16 introduction of the four MOX LTAs will have only an
17 insignificant impact. The question of what is
18 significant is ill defined in NRC parlance, as we all
19 know, but the first thing Duke should do is its own
20 risk calculation, which it hasn't done yet. Duke only
21 incorporated by reference the Department of Energy's
22 calculation from several years back from NEIS.

23 We've pointed out many places where that
24 calculation was inadequate, and we just think before
25 coming to a conclusion Duke should do a design

1 analysis and evaluate some of the uncertainties and
2 sensitivities associated with the issues that I've
3 discussed.

4 Again, four LTAs is a small fraction of
5 the core inventory. We understand that, but before
6 debating whether or not that's significant, we need to
7 know, have a good handle on that number, and we just
8 don't have that yet.

9 As far as Duke's comparison of the
10 increase in risk to that associated with other license
11 amendments such as power-up rates, I don't believe
12 that these comparisons are valid because the benefits
13 are different in each case. You're talking about a
14 power up rate. Obviously that is going to be
15 substituting for another source of electricity
16 generation and the risks and benefits associated with
17 that, but it's different than this particular
18 application of using MOX LTAs.

19 To conclude, BREDL is not seeking absolute
20 certainty in this proceeding, but we are only seeking
21 reasonable assurance that this program is going to
22 provide adequate protection of public health and
23 safety. We don't want to shut down every retest
24 assembly program and every fuel qualification program
25 in the world. We just think that the MOX LTAs are

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1 significantly different from LEU in U.S. experience,
2 but it's warranted to try to understand some of these
3 issues a little bit better than Duke has done.

4 And with that, I'll take your questions.

5 DR. POWERS: Are there any questions for
6 Dr. Lyman?

7 (No response.)

8 DR. POWERS: We now have a presentation
9 from Mr. Killar of the Nuclear Energy Institute.

10 MR. KILLAR: Good morning, gentlemen. My
11 name is Felix Killar. I'm the Director of Fuel Supply
12 and Material Licensees from Nuclear Energy Institute.

13 In my position one of my responsibilities
14 is for following the weapons disposition program, both
15 the ATU program and the plutonium disposition program,
16 and I have a very brief statement this morning.

17 First off, our policy. We certainly
18 support the plutonium disposition program. We feel
19 it's very similar to the high risk uranium program as
20 we're taking a very high, very reactive material,
21 diluting it down to a grade that could be used safely
22 with the power plants and dispositioning this material
23 so as not to be a hazard or potential threat to the
24 American public.

25 My second point is that we support the LTA

1 process for verification of fuel types and new fuel
2 types. This is just another iteration as similar as
3 they were talking about the other LTA program they
4 have at the Catawba reactor. This is another
5 application of the same process, and therefore it is
6 consistent with the use and safe operation of plants
7 to assure that we do have good prototypes, that we are
8 very happy and content with the safety of these things
9 going through the power plants in full batches.

10 And then the last point is the history of
11 the MOX LTA program internationally as well as here in
12 the United States we believe can be accomplished very
13 safely.

14 One of the disadvantages of being the last
15 speaker is that sometimes your points are taken. I
16 was going to refer to the Ginna experience as well as
17 the experience at the end of cycle with most of the
18 enriched reactors here in the United States were
19 reactors here in the United States. When you get to
20 the end of the cycle, you are basically running a MOX
21 reactor.

22 Now, there also is good experience with
23 Dairy Land reactor that had a number of MOX fuel
24 assemblies that ran a number of years as a
25 demonstration project and was a very successful

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1 program.

2 In fact, one of the benefits of that
3 program is that when they had an assembly that had
4 some problems that was a low enriched uranium
5 assembly, typically they would pull out one of the MOX
6 assemblies and use that as a substitute for the LEU
7 assembly for that cycle to get through the cycle.

8 So that's the three points I wanted to
9 raise this morning. I'm just basically talking in
10 support of this program going forward, and this
11 program going forward with the LTA program.

12 DR. POWERS: Could I ask you have you or
13 your colleagues done independent analyses of the
14 performance of these mixed oxide lead test assemblies?

15 MR. KILLAR: We have not done independent
16 analysis. We have reviewed the programs they've gone
17 through and to see that it is consistent with a
18 typical program, but we have not gone into any
19 independent analysis.

20 DR. POWERS: And you are satisfied that
21 they have taken appropriate steps?

22 MR. KILLAR: Yes, we are.

23 DR. POWERS: Thank you.

24 Any other questions?

25 (No response.)

1 DR. POWERS: Thank you very much.

2 With that I'll return it to Mr. Chairman.

3 CHAIRMAN BONACA: Okay. Thank you for the
4 presenters.

5 And we'll take a break until five after
6 11.

7 (Whereupon, the foregoing matter went off
8 the record at 10:47 a.m. and went back on
9 the record at 11:05 a.m.)

10 CHAIRMAN BONACA: We'll get back into
11 session.

12 And the next item on the agenda is risk
13 management technical specifications, and Professor
14 Apostolakis, you have the lead.

15 DR. APOSTOLAKIS: Thank you, Mr. Chairman.

16 On Subcommittees on Reliability and
17 Probabilistic Risk Assessment and on Plant Operations
18 held a meeting on March 25th of this year with
19 representatives of the industry and the NRC staff to
20 discuss risk management or risk managed technical
21 specifications. The purpose of the meeting was to
22 hear an overview of the status of the risk management
23 technical specifications, the so-called Initiative
24 4(b), risk informed completion times.

25 The effect of this initiative is to extend

1 the completion times from a nominal or current
2 completion time up to a predetermined backstop or
3 maximum using configuration risk management programs.

4 This initiative will require real time
5 capability and cumulative and configuration risk
6 matrices. The challenging part is the demand of a
7 high technical capability and scope of PRA, and this
8 will be a central theme to the discussion, whether
9 PRAs are up to the task.

10 And without further ado, I'll turn it over
11 to the staff. Who's starting?

12 MR. BOYCE: Yes, good morning. My name is
13 Tom Boyce. I'm the Section Chief in the Technical
14 Specifications Section of NRR.

15 With me today is the lead staff reviewer
16 for the risk management tech specs, Bob Tjader who
17 will be presenting; Mark Reinhart of the PRA Branch of
18 NRR. I also have Deputy Division Director for
19 Division of Inspection Program Management, Cindi
20 Carpenter, and various reviewers in the audience. So
21 we've come armed to bear here.

22 We're also lucky to have industry
23 presentations on some pilot programs, some of the
24 pilot plants: South Texas is with us, and you'll be
25 hearing from them. That's Wayne Harrison and Bill

1 Stillwell over here. Also Biff Bradley of NEI will
2 make a presentation.

3 As was previously stated, we last
4 presented to the full committee in November 2002,
5 where we covered the full gamut of the risk management
6 tech specs, and there are eight initiatives in the
7 risk management tech specs which you'll hear briefly
8 about.

9 But what we are here today is to focus on
10 Initiative 4(b), and that's what we talked last month
11 to the joint subcommittees on. The reason we wanted
12 to focus on 4(b) this time, it's the most aggressive
13 of the eight initiatives. It's the most heavily
14 reliant on a high quality PRA, and we think it's a
15 significant change in the way we've approached tech
16 specs.

17 As was stated, the current tech specs are
18 what I'll call static. If you have some equipment
19 that's inoperable, you start a plant shutdown at a
20 predetermined time, and that predetermined time is a
21 result of a review as part of the licensing process.
22 You know, you will start shutting down within six
23 hours, for example.

24 The change here is that this would allow
25 a more real time use of a licensee's PRA, and so what

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1 they do is they take a nonconforming condition, and
2 they would put it into their PRA and say, "Well, we
3 should be able to tolerate this nonconforming
4 condition or the equipment out of service for a
5 certain period of time," and that would constitute the
6 allowed outage time for that system before they
7 entered a shutdown process typically.

8 That's a significant change in the way we
9 license. It's a significant change in the way plants
10 are operated, and it would be a significant change to
11 the way we provide oversight of plant operations.

12 We're still early in this review process.
13 So we're not going to have all of the answers. We're
14 developing as we go.

15 We are looking for comments and feedback,
16 not a letter per se unless you're going to include
17 comments in a larger letter on risk for, say, the
18 staff's response to the recent SRM from the Commission
19 on balance of operational flexibility and PRA quality
20 or Reg. Guide 1.200, which you're going to hear this
21 afternoon or maybe 5069.

22 So as part of a larger mosaic, comments on
23 this might make stage. We intend to come back to the
24 ACRS as we get further down the road.

25 Any opening questions?

1 DR. LEITCH: I've heard the term "risk
2 informed" and "risk based." Now we come across the
3 term "risk management," "risk managed tech specs."
4 What significance should I interpret those words to
5 be?

6 MR. TJADER: We use tech specs to manage
7 the plant, and plus we're -- excuse me. The idea is
8 that we're managing the risk, and it's just a slight
9 nuance or change in terminology, nothing terribly
10 significant. We risk inform some of the specific
11 details in the tech specs, but when we perform a risk
12 assessment, then per (a)(4) or through the risk
13 management process that we're going to have with 4(b),
14 then we are going to manage the risk. We're going to
15 take compensatory actions and things like that.

16 So it's not that we're using a risk
17 informed approach. We're managing.

18 MR. BOYCE: Yeah, I'd like to expand on
19 that just a little bit. It's a similar approach to
20 what we've got in Reg. Guide 1.177, which says if
21 you've got equipment out of service, you wouldn't do
22 things that would add additional risks. So you might
23 shut down any maintenance in the switchyard. You may
24 not take out of service or do maintenance on
25 equipment in the other train.

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1 You wouldn't do something that would raise
2 the possibility of another problem keeping that
3 equipment out of service for a longer period of time,
4 and that's what I would call the management part.

5 But I think it's a terminology issue in
6 general.

7 Did you want to add something to that?

8 MR. REINHART: Yeah, just the thought
9 along with what Tom and Bob have said. If you look at
10 tech specs today, you're looking at one train, one
11 component. Looking at a risk management tech spec,
12 you're looking at the combination of the status of all
13 equipment at a given time. If more equipment was out
14 of service when, say, you lost a component, the AOT
15 may be actually shorter than what a tech spec would
16 provide, unless you put in place compensatory measures
17 or put some of that other equipment back in service.

18 If, on the other hand, there was no
19 maintenance going on, it might be a little bit longer
20 or a lot longer so that you could take your time and
21 perform your maintenance in a very orderly manner.

22 So again, what these two gentlemen said:
23 it's really a management -- it's part of risk
24 informed, but it's a managing the plant at the same
25 time.

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1 DR. APOSTOLAKIS: Are we going to discuss
2 this issue of whether equipment were already out, what
3 happens?

4 MR. TJADER: We could get into that detail
5 if you'd like to discuss it.

6 DR. APOSTOLAKIS: Right now or later?

7 MR. BOYCE: Later, please.

8 DR. APOSTOLAKIS: Okay. I'm a little
9 puzzled by your request that we shouldn't write a
10 letter unless we comment on this in a letter that
11 addresses bigger issues. Why is that? Why wouldn't
12 we write a letter, you know, and say this is what we
13 think about what's going on here?

14 MR. BOYCE: Oh, I didn't mean to imply
15 that we wanted to preclude a letter. If you thought
16 that there was something that we needed to consider,
17 please, write that letter.

18 I had thought really that to make it
19 clear, we weren't explicitly seeking a letter.

20 DR. APOSTOLAKIS: You're not requesting a
21 letter.

22 MR. BOYCE: Right.

23 DR. APOSTOLAKIS: Yeah, that's fine.
24 That's fine.

25 CHAIRMAN BONACA: Why don't we proceed

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1 then?

2 DR. APOSTOLAKIS: Yeah.

3 MR. TJADER: Okay. I'll provide an
4 overview of Initiative 4(b), and as I proceed in doing
5 that, if you desire more detail, some of the specific
6 details with inoperabilities come up, feel free to ask
7 that. I know with the subcommittee we discussed some
8 of that.

9 I'll also discuss it in the context of the
10 other risk management tech spec initiatives.

11 You've previously received some of the
12 submittals that we received from industry, the risk
13 management guidance document, which is basically the
14 process which will be utilized to implement Initiative
15 4(b). Biff Bradley later will present an overview of
16 the risk management guidance process, and South Texas
17 will discuss their pilot proposal later. We have
18 Wayne Harrison and Bill Stillwell with us today as Tom
19 mentioned to discuss their proposal. Opening and
20 closing comments.

21 Risk management tech spec Initiative 4(b)
22 is dependent upon PRA quality. Initiative 4(b)
23 requires a quantitative risk assessment to determine
24 the appropriate risk informed completion time.

25 Communication with and training of the

1 headquarters staff and regions are essential for
2 successful implementation of Initiative 4(b).
3 Initiative 4(b) is currently participating in the
4 NRC's risk informed environment initiative, which is
5 related to the communication, education, and
6 acceptance by the staff of the risk management tech
7 spec initiatives as well as other regulatory risk
8 initiatives.

9 We're early in the Initiative 4(b)
10 process. Initiative 4(b) is in a proof of concept
11 stage, and we're going to learn as we proceed through
12 the process.

13 DR. APOSTOLAKIS: Whose comments are
14 these?

15 MR. TJADER: The feedback?

16 DR. APOSTOLAKIS: You say opening and
17 closing comments.

18 MR. TJADER: Well, the direction was that
19 we should provide conclusions of --

20 DR. APOSTOLAKIS: From us?

21 CHAIRMAN BONACA: Yes.

22 DR. APOSTOLAKIS: Okay.

23 DR. SHACK: That's how they're supposed to
24 make presentations, George.

25 DR. SIEBER: Yeah, we aren't supposed to

1 ask questions.

2 CHAIRMAN BONACA: That's right, which we
3 already have. All right.

4 MR. TJADER: Dr. Apostolakis mentioned on
5 the 25th of March we met with Reliability and PRA and
6 the Plant Operations Subcommittees, and they provided
7 us some feedback, and I have synopsized those here,
8 and feel free to correct me if I didn't get any of
9 them complete or totally correct.

10 In general, the comments were that it's a
11 good idea to risk inform tech specs, and in general
12 the structure of Initiative 4(b) as it is right now is
13 a good start.

14 The issues that were brought up, roughly
15 in descending order of importance, are with respect to
16 configuration risk monitors and assessment tools that
17 are utilized in the risk assessment process, we need
18 to know the extent of the PRA incorporation into those
19 monitors and tools, and we need to be assured that
20 there's adequate QA and QC of the software and the
21 updating of that software that is utilized in the
22 monitors.

23 We need to be aware of what's in the PRA
24 and its impact on the completion times, and we need to
25 design metrics to provide licensees incentive to fix

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1 the problems within the existing completion times in
2 addition to the existing incentives that already exist
3 in the maintenance rule as it exists now, in other
4 words, the availability and reliability of equipment.

5 It was also mentioned that we need perhaps
6 front stops were not adequate, potentially not
7 adequate, and while my gut feel is that front stops as
8 they are right now -- now we'll get into detail of
9 what a front stop is and a backstop, but basically the
10 front stop is the current completion time of existing
11 tech specs. My gut feel is that they are adequate
12 for, in general, four single system inoperabilities
13 and haven't seen any cases where they aren't yet, but
14 in the event that there may be one, perhaps a review
15 of front stops ought to be conducted to insure that
16 Initiative 4(b)'s structure is sound.

17 There was some discussion with regard to
18 times. In other words, it's proposed that 24 hours be
19 given to perform risk assessments when subsequent
20 configuration changes occur in the plant, and you're
21 already in tech specs, and we recognize that 24 hours
22 is a long period of time, and that it can be done in
23 significantly shorter period of time than 24 hours.
24 Twenty-four hours, I think, in general is to get the
25 approval process through.

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1 DR. KRESS: There was also some discussion
2 of what zero time was.

3 MR. TJADER: Oh, what the zero entry. If
4 you need to go into that further, basically it's when
5 you enter the spec. That's time zero.

6 DR. KRESS: Even though it may have been
7 some time down the road when you enter a new
8 configuration due to a --

9 MR. TJADER: Yeah, until the LCO time zero
10 is consistent and time zero is the time of entry of
11 the spec.

12 MR. BOYCE: Right, and you thought that
13 was conservative.

14 DR. KRESS: Well, it definitely was
15 conservative, I thought, yeah. You know, you enter
16 into the tech spec and you're at time zero, and you've
17 got a given risk configuration. Then something
18 happens down the line and you merge into a new risk
19 configuration.

20 In order to calculate the acceptability of
21 this, you start it all the way back at time zero
22 again. So it is definitely --

23 MR. TJADER: Well, it just seems to me
24 there's a cumulative risk that may be invoked, and if
25 you're using cumulative risk limits, then you've got

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1 to take it into account from time zero.

2 DR. APOSTOLAKIS: And when are we going to
3 talk about these limits? You will cover that?
4 Because I'm a little confused there about the limits.
5 So tell me when would be a good time to raise the
6 issue.

7 MR. BOYCE: Maybe during the example, when
8 we get to the example slides because that's where it
9 came up in the subcommittee presentation.

10 MR. TJADER: And not only that. I think
11 that South Texas and NEI have some specific slides
12 that address, you know, the limits and the accumulated
13 risk and how it's conducted and things. So utilizing
14 some of their expertise in slides would probably be a
15 good time to do that, too, when they make their
16 presentations.

17 DR. APOSTOLAKIS: Very good.

18 MR. TJADER: And then finally we need to
19 maintain oversight of changes to the PRA after
20 approval of Initiative 4(b) to insure that we are
21 aware of the effects of the configuration rather than
22 from the program and process.

23 Principles for risk management tech spec
24 to the development --

25 DR. APOSTOLAKIS: Let's stop what we're

1 doing here because I'm a little confused.

2 MR. TJADER: Okay.

3 DR. APOSTOLAKIS: Okay. You listed the
4 comments that you received from the subcommittee, and
5 you will address how you're going to resolve these or
6 did you already give your answers?

7 For example, when you say on Slide 4 there
8 is an issue of QA of software in the updates, I mean,
9 are you planning to do anything about it or you're
10 just acknowledging that the committee --

11 MR. TJADER: Yes, we are definitely
12 planning to address that.

13 DR. APOSTOLAKIS: And when will we hear
14 about it?

15 MR. BOYCE: Not at this meeting.

16 DR. APOSTOLAKIS: Not at this one. Okay.

17 MR. TJADER: We are not prepared to
18 resolve some of these issues.

19 DR. APOSTOLAKIS: Now I understand.

20 MR. TJADER: We are early in the process.

21 DR. APOSTOLAKIS: I understand. Something
22 is wrong with this meeting. You seem to leave me
23 behind all the time. Okay. I'll pay more attention.

24 MR. TJADER: It may be that you're way
25 ahead of us is what the problem is.

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1 DR. APOSTOLAKIS: Okay. Now it's clear.
2 Thank you.

3 MR. TJADER: These are feedback. These
4 are things that the subcommittee brought up last
5 meeting. You brought up the configuration, risk
6 monitors, and we fully agree that these are things
7 that we need to be aware of and how we affect the
8 configuration of risk management process.

9 DR. APOSTOLAKIS: As a side remark, the
10 committee may be briefed on one or two risk monitors
11 soon because remember we were supposed to go to an
12 office some time ago. Now they're going to come here,
13 maybe SE or somebody else. Ms. Weston is working on
14 that, and that may happen fairly soon.

15 DR. POWERS: How come you can never get us
16 there?

17 DR. APOSTOLAKIS: I don't understand that.

18 DR. POWERS: I mean, you just never make
19 the case very strongly.

20 DR. APOSTOLAKIS: I never make the case?

21 DR. POWERS: You never make the case very
22 strongly. You aren't persuasive.

23 DR. APOSTOLAKIS: I made it.

24 Okay. So the committee may -- will
25 actually, not may -- will be briefed as to what the

1 risk monitor does, what the issues are. We're going
2 to see nice figures, pictures, and so on. So that
3 will happen soon.

4 Okay. Thanks.

5 MR. TJADER: Okay. Principles of risk
6 management tech spec development in addition to
7 following Commission guidance in the development of
8 the risk management tech specs initiatives, we seek to
9 achieve coherence with other risk informed regulatory
10 developments such as the maintenance rule which we
11 utilize in our process; PRA quality, which we're
12 dependent upon; and 5069, which may affect some of the
13 later initiatives, like Initiative 8.

14 We take credit for and build upon existing
15 5065, A(4), maintenance rule, configuration risk
16 management programs, and the risk management tech
17 specs initiatives. We must insure that licensee's
18 risk submittals must be standard for quality and
19 comprehensiveness. Submittals must meet Reg. Guide
20 1.200, ASME, and other standards.

21 We must involve the NRC staff with
22 cognizance for operation training, inspection,
23 maintenance, the regions, the SDAs, and risk
24 assessment staff.

25 We must involve the staff to insure a

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1 quality product and to insure overall support by the
2 staff.

3 DR. APOSTOLAKIS: With respect to quality,
4 is this now the beginning of the era when PRA will be
5 used in real time do you think?

6 MR. BOYCE: Yes.

7 DR. APOSTOLAKIS: Are we getting there?
8 Has anybody thought about whether the
9 existing PRAs which were developed for, you know,
10 assessment purposes without any pressure of time,
11 whether they are actually adequate for this thing?

12 Maybe they are, but is that something we
13 ought to look into, Mark?

14 MR. REINHART: I think we're looking for
15 a very substantially improved or higher quality PRA
16 than most plants have today to support the Initiative
17 4(b), and I think we've communicated that to industry,
18 and they're hopefully going to come back and
19 demonstrate to us that they have that.

20 If you look at the staff requirements
21 memorandum that has this on a phased approach, we're
22 saying this is a proof of concept which is really
23 parallel to that phased approach, and for a 4(b) plant
24 that would be an accelerated development of a high
25 quality PRA. There will be areas where there aren't

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1 standards. So we're going to have to come to grips
2 with what are we going to do to review that. What are
3 we going to do to make sure that the content is where
4 we are wanting to go and that we're not out in left
5 field from where we go when this standard is
6 developed.

7 At the same time, we don't want to say,
8 "Well, it's good enough for now and we'll fix it
9 later." To have a plan, go out and manage their
10 configuration based on PRA information, along with the
11 deterministic also, we need to have a substantial
12 confidence in that PRA.

13 DR. APOSTOLAKIS: So this PRA then, as you
14 said, clearly will have to do more than just what the
15 available standards dictate.

16 MR. REINHART: Yes.

17 DR. APOSTOLAKIS: And you will not give
18 the review of those low priority, will you, of the
19 extra work?

20 MR. REINHART: No. We've talked about
21 this, and we're saying obviously we can't look at
22 that, the low priority as defined under the SRM. We
23 have to have a separate approach here.

24 DR. APOSTOLAKIS: Okay.

25 MR. TJADER: And in general, the existing

1 PRAs out there are not adequate to implement
2 Initiative 4(b). There may be a South Texas, may be
3 a San Onofre that that are close to being adequate or
4 are adequate, but most aren't. Fort Calhoun has
5 volunteered to be a pilot, as I'll bring up later, as
6 has Hope Creek plants, to be a pilot for Initiative
7 4(b).

8 In both cases, for them to be pilots will
9 require them to upgrade their PRAs and make adequate,
10 and the reviews currently under Reg. Guide 1.200 for
11 quality, we recognize that that's just a starting
12 point for assuring quality and that eventually Reg.
13 Guide 1.200, when it gets addenda and things like that
14 that are coming in, may be adequate for it, but it has
15 got to be Reg. Guide 1.200-plus at the moment to
16 insure the quality.

17 MR. BOYCE: And just one more point. If
18 these pilot plants do upgrade their PRAs and make them
19 as complete as we'd like, the PRAs for this
20 application, and we reviewed it and it was approved,
21 the PRAs would probably be more than adequate for
22 other risk informed applications without further
23 review.

24 So we think this is a very challenging
25 application.

1 MR. TJADER: Okay. Just a quick status of
2 the other initiatives. This is to give you an idea
3 where Initiative 4(b) fits in with the other
4 initiatives.

5 Basically the initiatives fall into four
6 general categories. The first category include the
7 two initiatives that have already been approved.
8 Initiative 2, missed surveillances, and Initiative 3,
9 mode change flexibility, they rely extensively on
10 existing A(4) type configuration risk management
11 programs. They are in most respects the least risk
12 significant of the initiatives.

13 The net set require prior analysis of
14 specific plant configurations, and they are the next
15 ones that are soon to be approved. We hope within the
16 next year. They include Initiative 1, modified end
17 stage, that is, shutting down to full repairs to hot
18 shutdown rather than going all the way to cold
19 shutdown when it's risk informed to do that for
20 specific plant configurations or specific
21 inoperabilities.

22 Initiative 6, entry times into shutdown
23 and entry times into 303 action statements for
24 specific equipments and configurations. There can be
25 extended times. Rather than just allowing one hour

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1 preparation to enter shutdown, they may be risk
2 intelligent to provide additional time.

3 Initiative 7, non-tech spec support
4 systems' effect on tech spec systems, i.e., snubbers,
5 hazard barriers, and it isn't always the smart thing
6 to do to automatically declare the supported system
7 inoperable because the snubber is inoperable. That's
8 in general what that issue is.

9 And those three, as I said, we have
10 proposals in house for all three of those and for
11 certain vendor types, we are ready almost to go
12 forward and approve some of those.

13 The third category requires quantitative
14 risk assessments. They require extensive quantitative
15 PRA based risk assessment, and they are Initiative 4,
16 the flexible risk informed completion times, which is
17 a major concern today, and Initiative 5 is
18 surveillance frequency programs.

19 And then the final category is somewhat in
20 the future. That's an Initiative 8, and it requires
21 or it involves potentially relocating non-risk
22 assessment systems from tech specs. It will involve
23 rule-making because it will require replacing the
24 existing 5036 deterministic criteria in the tech specs
25 with a risk based criteria for determining what should

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1 be in specs, and that's some time down the road.

2 Initiative 4, risk informed completion
3 times. The effect of Initiative 4(b) is to extend the
4 existing completion times and tech specs from a
5 nominal or current completion time value up to a
6 predetermined backstop maximum using a configuration
7 risk management program. This is under development.
8 Initiative 4(b) involves applying a process which will
9 be defined in the risk management guidance document,
10 which you have the first rough draft of in it so as to
11 use this risk management guidance document process to
12 determine the risk informed police time.

13 The process will require PRA technical
14 quality and adequacy which will be addressed to some
15 extent as I already mentioned by Reg. Guide 1.200 so
16 that a real time quantitative capability will exist in
17 order to realistically implement 4(b).

18 In addition, it will require configuration
19 of cumulative risk metrics so that we can determine
20 what the risk informed completion time should be as
21 plant configuration evolves and also to evaluate the
22 overall process as time goes on.

23 The current status --

24 DR. LEITCH: Do you visualize a
25 preestablished set of plant conditions, many different

1 conditions, where this has all been worked out in
2 advance?

3 MR. TJADER: That's the South Texas way of
4 doing it. There are two ways of doing it. There
5 are --

6 DR. LEITCH: Or more on-line training that
7 now we find ourselves in this particular situation.
8 We'll immediately do a --

9 MR. TJADER: Do an on-line configuration
10 risk assessment utilizing an on-line monitor, such as
11 possibly San Onofre might do. There's a couple of
12 ways to do it, and perhaps a blended type approach
13 between the type that could be utilized to get the end
14 result.

15 DR. LEITCH: So if you did the former,
16 that is, if you had the preestablished scenarios,
17 would they require NRC approval in advance or it's the
18 methodology in the PRA that you're approving?

19 MR. TJADER: You have to have confidence
20 that the methodology -- it's primarily the
21 methodology --

22 DR. LEITCH: Yeah.

23 MR. TJADER: -- that they utilize to get
24 to those. We have to be confident in their PRA and
25 that their means of getting those cut sets and those

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1 configurations determine -- and South Texas will go
2 into their process a little bit. They have
3 approximately 20,000 pre-configured plant
4 configurations. We certainly can't I don't think in
5 a realistic time go in and approve each and every one
6 of those.

7 However, we're going to take and review a
8 set of those.

9 DR. LEITCH: But say they come to number
10 1,502 and they now find themselves in this situation.
11 Can they just go ahead and do that?

12 MR. TJADER: Once we approve it.

13 DR. LEITCH: Once you approve it, but I
14 mean, you're not going to approve each one, but you're
15 going to approve the methodology and approve the PRA
16 quality and the QA aspects of it and so forth.

17 MR. TJADER: And of course, South Texas
18 requires extensive updating of their sets as they
19 update the PRA and things. It seems to me to be
20 rather work intensive.

21 DR. APOSTOLAKIS: So a predetermined
22 backstop maximum is not the 30 days that you're
23 putting there for defense in depth purposes. It's the
24 calculated.

25 MR. TJADER: No, there's three things.

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1 There's the front stop and there's the risk informed
2 completion time, which could extend the front stop up
3 to the backstop, which would be the 30 days, which is
4 -- 30 days, I might add, is what the proposed backstop
5 is at the moment.

6 DR. SIEBER: Right.

7 MR. TJADER: It seems like a reasonable
8 period of time, but --

9 DR. APOSTOLAKIS: But the flexible time --

10 MR. TJADER: The risk informed provision.

11 DR. APOSTOLAKIS: -- doesn't have to be
12 predetermined.

13 MR. TJADER: No, it does not.

14 DR. APOSTOLAKIS: They can do it in real
15 time.

16 MR. TJADER: That's right, yes.

17 DR. APOSTOLAKIS: Now, if they choose for
18 certain common configurations to have predetermined
19 it, that's fine.

20 MR. TJADER: That's correct.

21 DR. KRESS: The backstop could be less
22 than the 30 days if the risk configuration says it
23 should be less. If you just say that's a maximum --

24 MR. TJADER: I mean, what is proposed now
25 is a standard 30-day backstop. In other words, no

1 system should have more than 30 days to be inoperable
2 or be in an action statement, in general, and if you
3 perform a process, a risk assessment process that
4 determines that the appropriate completion time is
5 less than 30 days, that then is not a backstop.
6 That's the risk informed completion time.

7 DR. KRESS: That's when you have to do it
8 then.

9 MR. TJADER: That's what you have to deal
10 with, not the backstop. In other words --

11 DR. KRESS: It's only if that
12 determination exceeds the 30 days. then you would go
13 ahead and use the 30 days.

14 DR. APOSTOLAKIS: Right. In fact, I saw
15 in the Westinghouse document there were several
16 figures. For a lot of these actions or configurations
17 the risk informed limit is much larger than the 30
18 days. There are several others that is lower. So
19 they stop there.

20 MR. BOYCE: And just to come back to the
21 risk monitor issue, the South Texas project approach
22 is to use what we'll call a database type approach of
23 pre-analyzed conditions, and so that constitute their
24 risk assessment tool. the other risk monitors would
25 be a subset of what we're calling a risk assessment

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1 tool, a real time risk monitor, a database approach or
2 a blend of the two is what we're struggling with is
3 how do we approve those in advance, and what we're
4 looking at is as a pilot this is supposed to be a
5 generic approach. so that's why it's important
6 whether we approve the database approach or risk
7 assessment tool approach in general or some sort of
8 risk monitor. We're not clear.

9 DR. KRESS: Well, in general the South
10 Texas approach can make use of a much higher quality
11 PRA, it seems to me like, than the risk monitor.
12 Well, they've got plenty of time to sit there and so
13 all of their scenarios and include every -- you know,
14 make the cut sets different and so forth.

15 DR. APOSTOLAKIS: Yeah.

16 DR. KRESS: But if you've got a risk
17 monitor, it's more of an abbreviated PRA in my
18 opinion.

19 DR. APOSTOLAKIS: Not anymore.

20 DR. KRESS: Not anymore?

21 DR. APOSTOLAKIS: We'll find out. We'll
22 find out.

23 DR. KRESS: We will find out.

24 DR. APOSTOLAKIS: But the down side of it
25 is if you don't pre-analyze the configuration --

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1 DR. KRESS: If you've got one you haven't
2 pre-analyzed, you have to do something, yeah.

3 CHAIRMAN BONACA: The question I have is
4 these plants also do on-line maintenance, and so say
5 that you have a component in tech specs that is pushed
6 close to the backstop. They still can't take out the
7 components of the service and do maintenance on those.
8 I mean, right now you have control on the tech spec
9 portion because you have communication coming to you
10 that the components of the service and determine that
11 20 days is acceptable. Okay?

12 How do you -- I'm sure that the plant has
13 to now take into consideration still all the other
14 components that are being taken out of service
15 simultaneously, right?

16 MR. REINHART: Oh, absolutely.

17 CHAIRMAN BONACA: Is there a process to
18 deal with that? I mean to control it or --

19 MR. TJADER: Right. In the process and
20 when we get to Slide 9, which is just actually -- I
21 think we're just about there. I mentioned the pilots,
22 the proposed pilots. Here's the positive: front
23 stop, which is the current completion time,
24 configuration risk management proposed program based
25 completion time, the backstop proposed is 30 days.

1 Here is what we're talking about.

2 This is a typical tech spec condition,
3 typical example. This exists in the risk management
4 guidance document. It's taken out of that, their
5 proposal. A typical condition might be one subsystem
6 inoperable, and under existing specs, the required
7 action would be perhaps B(1), restore subsystem to
8 operable status. The completion time is 72 hours.

9 What the risk management tech spec process
10 and the risk management guide proposes is adding
11 required actions B(2)(1), B(2)(2), and B(2)(3).
12 B(2)(1) is to determine -- in other words, you're
13 restoring, attempting to restore the subsystem to its
14 operable status within 72 hours. You then at some
15 point determine that you're probably not going to be
16 able to do that within 72 hours.

17 So within that existing 72 hours, within
18 that existing completion time, you determine -- you
19 perform your risk assessment and you determine what is
20 the appropriate extension beyond 72 hours and what is
21 acceptable at that threshold.

22 Okay, and then you will utilize that risk
23 assessment time, and then B(2)(2), which is verify
24 that completion time beyond 72 hours remains
25 acceptable, and then if you say in parentheses, i.e.,

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1 within 24 hours, 24 hours is proposed. Hours of a
2 subsequent configuration change; any time there is a
3 subsequent risk significant configuration change to
4 the plant, the risk assessment must be re-performed
5 and to verify that the completion time is accurate for
6 the existing condition.

7 And then B(2)(3) then is restore the
8 subsystem to operable status at a maximum 30 days or
9 the completion time that's determined, whichever is
10 less.

11 DR. KRESS: And now I can see for an
12 emerging condition that you weren't expecting that the
13 24 hours might be appropriate, but it seems to me like
14 for -- take this one example, the HPSI subsystem
15 inoperable. You could already predetermine a backstop
16 for that, assuming no emerging condition.

17 So why should you have this 24 hours
18 there? You could already have a -- they have another
19 line there that says "or extend to such-and-such a
20 level," number of hours, if it can't be completed in
21 72.

22 Can you predetermine that one?

23 MR. TJADER: Oh, absolutely, and in fact,
24 that is the case. I mean, under the CE proposal, they
25 have pre-analyzed a lot of different --

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1 DR. KRESS: So it would already have --
2 they would already have the backstop, assuming nothing
3 happens that they hadn't anticipated.

4 MR. TJADER: They pre-analyzed some of
5 those situations, and plus --

6 MR. REINHART: Can we jump in?

7 MR. TJADER: Yeah.

8 MR. REINHART: One of the questions that
9 has to be determined: what is the integration of
10 programs? For instance, if it's just one component
11 here and it's predetermined, it's really done like you
12 say, or if it's just one component, maybe they could
13 take some time.

14 But under the maintenance rule, every time
15 a configuration changes, you have a much shorter time
16 to run an analysis, and so we have to come to an
17 agreement with the industry and then get that put in
18 the process: really what is an appropriate time,
19 given an emergent condition, once that configuration
20 changes to make the determination? Because what if
21 it's much less? You know, that emergent condition --

22 DR. KRESS: What if it's less than the 24
23 hours?

24 MR. REINHART: Exactly.

25 DR. KRESS: That should be the

1 determinant, and we don't know that ahead of time.

2 MR. REINHART: Yes, you're right, and so
3 we need confidence that that will be quickly brought
4 to light and an action taken appropriately.

5 MR. BOYCE: If I could generalize your
6 questions, why don't we reanalyze all of the front
7 stops using a risk approach?

8 And that seems to make sense technically
9 from a licensing standpoint. All of those front stops
10 were put in place with a lot of thought, deterministic
11 type of thought, and a lot of them have conditions
12 that were place on the plant as part of safety
13 evaluations and amendments in the past.

14 And so what would happen is we would end
15 up doing two reviews, one for a risk based approach
16 and one to research the licensing history to make sure
17 we completely understood it.

18 DR. KRESS: That would be a pretty big
19 task.

20 MR. TJADER: It increases the scope of the
21 review, and I guess Fort Calhoun is -- Bob has
22 actually tried to move in the risk based direction on
23 the front stops, but that's the internal process we
24 have to go through to make sure that's right.

25 MR. REINHART: And, again, I think we

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1 really have to come to grips with what does this front
2 stop mean because that can't be just a buy time where
3 you do nothing.

4 If configurations emerge that we need
5 action and analysis before that front stop, the
6 program has to clearly articulate when and how that's
7 taken, and I think that's one of the things we need to
8 work out.

9 CHAIRMAN BONACA: You've got to have those
10 front stops. Many of them are just historical. I
11 mean, you're put there, and there wasn't much of a
12 meaning, and then they became important because
13 everybody always saw 72 hours. So 72 hours seems --
14 but in reality there wasn't much behind that.

15 MR. REINHART: And another way, say,
16 looking down the road, when some of these systems
17 become very flexible and very usable, what's the point
18 of having the front stop. I mean, the plant is going
19 to be analyzing their condition as they go along, and
20 as soon as something changes, they'll be able to see
21 what that does to the risk and take appropriate
22 action. That's managing the plant using --

23 MR. TJADER: With respect to that 24 hours
24 with regard to the completion time of B(2)(2), Fort
25 Calhoun is the proposed pilot for the CE generic

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1 submittal, which is the HPSI, single system HPSI
2 pilot, and they recognize the 24 hours is probably
3 more than is necessary for this initial risk
4 assessment.

5 But we have discussed various things, such
6 as maybe having one hour to do a predetermination that
7 it is acceptable, and then to do a more thorough PRA
8 based review and approval, management approval that
9 the 24 hours would be utilized for that.

10 But 24 hours is not yet approved or hard
11 and fast.

12 DR. KRESS: Yeah, I think that's going to
13 be a problem, and the basic concept is you don't want
14 to subject this surrounding population around this
15 plant to a given risk over a given amount of time, and
16 it's cumulative. It's a cumulative risk that needs to
17 be added up over that time.

18 And you know, you're not ever going to
19 manifest that risk, hopefully, but the concept is you
20 don't want to subject them to an unacceptable level of
21 risk, and which has time in it. It's an integral,
22 risk times time or integral CEF time to time or LEU
23 time to time.

24 So the 24 hours is something that if you
25 enter into a condition where that 24 hours would have

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1 subjected them to a higher level that its acceptable
2 risk, then the 24 hours is not appropriate, and it
3 seems to me like you could almost predetermine some
4 configurations where that 24 hours would not be
5 acceptable, like so many subsystems out of operation
6 at the same time.

7 And these conditions where the 24 hours is
8 no loner acceptable, then you have to shut down or
9 something. That would be the only way to me to accept
10 some value for this reconfiguration calculation. You
11 have to have some predetermination that some
12 configurations are just not acceptable over that 24
13 hour period.

14 MR. REINHART: I just want to add, again,
15 while the 24 hours is proposed, we need to work out
16 what's really reasonable and accomplishable here.

17 DR. KRESS: Yeah. It may be that 24 hours
18 may even be, you know, -- it might even be longer is
19 acceptable.

20 CHAIRMAN BONACA: One thing that comes to
21 mind here, you know, let me take the example of the
22 HPSI system. The value of the 72 hours as a front
23 stop is to set some kind of urgency that one knows
24 that this is maybe a system that you want since in the
25 tech specs you would like to restore it as soon as you

1 can.

2 On the other hand, you can determine that
3 you can live with it for ten days or whatever, and so
4 you can demonstrate that 30 is a part of that. But
5 I'm thinking about just, you know, the example of a
6 HPSI system. I have the four trains. So I go to the
7 Option B, and now I determine that my trains are not
8 individually this significant. So already I'm doing
9 less about those systems.

10 Then I have this evaluation here that
11 says, well, I've got four and very likely I can stay
12 30 days with the situation down. I guess where I'm
13 going is you may have a situation where on a risk
14 basis and with some justification, you have a lot of
15 systems maybe that are not fully operable for some
16 extent of time.

17 I don't think that that's what the plants
18 want to do.

19 MR. REINHART: No, n.

20 CHAIRMAN BONACA: So how do you prevent
21 that kind of situation from evolving? Because, I
22 mean, you may have 103 plants doing it right, and then
23 somebody abusing that process by having, in fact, a
24 lot of systems out.

25 MR. REINHART: The intent is that when a

1 piece of equipment becomes inoperable, the plant
2 starts right then their preparation to repair that and
3 restore it to operable.

4 The bigger picture is to focus on
5 accomplishing that and not go through a plant
6 transient unnecessarily. It's not to get a
7 relaxation. One caveat could be if there's three
8 pieces of equipment out, you use your risk assessment
9 to tell you which is the most important to get back
10 first. You get that back, and which is the second
11 most important.

12 CHAIRMAN BONACA: So you really are
13 working out the issues, yeah.

14 DR. APOSTOLAKIS: It's conceivable that
15 you should have three pieces of equipment and say for
16 each one you had a 72-hour front stop, but because you
17 have three, many you have to do it in 30 hours.

18 MR. REINHART: Yes, exactly.

19 DR. APOSTOLAKIS: How is that done? I
20 mean, is that allowed? Is that mandated here that you
21 do that?

22 MR. TJADER: No, the risk management
23 guidance document, which will be the guidance or the
24 procedure, the process to be utilized, we envision.
25 It's not in there yet, as you can see, but we envision

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1 requiring that as soon as the second piece of risk
2 significant equipment, whether it's tech spec or not,
3 becomes inoperable, that you are no longer in front
4 stop space.

5 You're in front stop space for single
6 system inoperability.

7 DR. APOSTOLAKIS: Okay, okay.

8 MR. TJADER: But as soon as the second one
9 becomes inoperable, you are then in the risk
10 assessment space, risk informed completion time space
11 determination.

12 MR. REINHART: I think there's three
13 periods of time that we need to look at. It's a
14 planning time, a real time when things are actually
15 happening and a post evaluation. I think all of the
16 pieces have to fit together here, and particularly in
17 real time that licensee has to be tuned to do what's
18 the safe thing to do right now.

19 DR. APOSTOLAKIS: Well, yeah, but I mean
20 we could say the regulations do the safe thing.

21 MR. REINHART: Well, I mean as far as
22 managing the risk, but then you have the cumulative
23 after a year or a cycle. You can go back and evaluate
24 your program and say, "How could I have done it
25 better? How can I approve it?"

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1 There's different ways to use that risk to
2 evaluate and manage your plan.

3 DR. KRESS: Let's say you're operating
4 alone with one system map and you've got a risk
5 informed front stop and you move along and you still
6 haven't got it back in operation yet and then just a
7 similar chain goes out of operation, and you've got
8 two of them now. And you calculate the amount of
9 time it takes to reach your reach acceptance criteria,
10 but that's too short to get both of these back in
11 operation or get either one of them back in operation.
12 Now, what do you do? Do you have to shut down when
13 you reach that?

14 MR. TJADER: Yes, right. That's a typical
15 action.

16 DR. KRESS: That's a typical action to
17 shut down?

18 MR. TJADER: Typical action.

19 DR. KRESS: Okay.

20 MR. REINHART: Or go to an appropriate
21 mode. It might be --

22 DR. KRESS: It may be a hot shutdown or
23 some --

24 MR. BOYCE: Three, oh, three says, you
25 know, shut down to hot standby and then cold shutdown,

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1 and then it continues walking till you get down.

2 DR. APOSTOLAKIS: Mario, what time do we
3 have? We started 20 minutes late.

4 CHAIRMAN BONACA: The backstop.

5 (Laughter.)

6 CHAIRMAN BONACA: Twelve, forty-five
7 because then we have the meeting with Mr. Paperiello
8 who's coming.

9 DR. APOSTOLAKIS: We have more
10 presentations. So maybe, Bob, can you speed it up?

11 MR. TJADER: Okay. I'll try to run
12 through this if I can here.

13 Potential implementation structure.
14 Basically we envision that program requirements will
15 be stipulated in the tech spec admin. control section.
16 In other words, the PRA quality Reg. Guide 1.200 will
17 be referenced and required, and there may be Reg.
18 Guide 1.200-plus.

19 Essential guidance documents, such as Reg.
20 Guide 1.177 and the risk management guidance document,
21 which is the process there, would be, we envision,
22 would be referenced in the admin. control section of
23 the tech specs.

24 There will be licensee and industry
25 program --

1 DR. APOSTOLAKIS: That's an interesting
2 point. One, one, seven, seven refers to permanent
3 changes, right?

4 MR. TJADER: Correct.

5 DR. APOSTOLAKIS: So here, huh? Blast.
6 Oh, so what --

7 MR. TJADER: We envision that possibly
8 1.177 has to be enhanced to allow for guidance on how
9 to approve, you know --

10 DR. APOSTOLAKIS: Even temporary.

11 MR. TJADER: -- limits for approving
12 certain forms --

13 DR. APOSTOLAKIS: But the existing one is
14 for permanent change.

15 MR. TJADER: That's right.

16 DR. APOSTOLAKIS: Okay. Now, if we go the
17 South Texas way where they predetermine everything,
18 then 1.177 applies because this is a permanent change.
19 Whereas Southern California using a monitor is not
20 under 1.177 because it's not change.

21 DR. KRESS: No.

22 DR. APOSTOLAKIS: Why not? It's not
23 permanent. They recalculate all the time.

24 MR. REINHART: I think we have to --

25 DR. APOSTOLAKIS: Excuse me. Are they

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1 correct or not?

2 DR. KRESS: No, they're conceptually the
3 same.

4 DR. APOSTOLAKIS: Your no refers to the
5 fact that we're not going to allow that.

6 DR. KRESS: NO, they're conceptually the
7 same.

8 DR. SHACK: You're allowing a certain
9 amount of cumulative risk, and whether it's rising
10 from a permanent change or a temporary, you know, what
11 you want to fix is the amount of cumulative risk
12 you're permitting.

13 DR. KRESS: That's right. That's right.

14 MR. REINHART: I might put some words into
15 South Texas' mouth here, but if I'm understanding what
16 they're saying, they will predetermine a large number
17 of configurations, but if they have one that's not in
18 their repertoire, they also have the capability to
19 handle it --

20 DR. SHACK: I think we need to invite them
21 up here.

22 DR. APOSTOLAKIS: I understand that, but
23 I mean, everything in 1.177 assumed permanent changes.
24 So I don't see why Southern California Edison should
25 have to comply with this if they're recalculating all

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1 the time. We're making an additional assumption.

2 MR. TJADER: Well, if it doesn't apply to
3 them, then obviously we wouldn't put that in the
4 admin. control center.

5 DR. APOSTOLAKIS: The incremental core
6 damage probability was determined having in mind
7 permanent.

8 MR. REINHART: We will need additional
9 guidance whether it's a modification to 1.177 or an
10 additional reg. guide. Somehow we have to account for
11 both of these.

12 DR. APOSTOLAKIS: This is the plus then.

13 MR. TJADER: That's the plus.

14 DR. APOSTOLAKIS: Okay. Let me start
15 there. Okay.

16 MR. TJADER: There will be licensee
17 industry program guidance for implementing Initiative
18 4(b). That may or may not be required in tech spec
19 admin. controls section, and plus oversight guidance
20 must be established.

21 Initiative 4(b) relies on PRA quality, use
22 of real time PRA results to determine completion times
23 we discussed. It's significant change to the current
24 usage of licensee's use of PRA and will entail a
25 significant change to NRC review and oversight.

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1 Therefore the PRA modeling configuration,
2 risk management process and tool must be of high
3 quality and show acceptable results.

4 Pilots for PRA quality and Initiative 4(b)
5 are being implemented in parallel at the moment. Four
6 of the five, Reg. Guide 1.200 PRA quality pilots
7 involve tech spec amendments. There's SONGS, which is
8 a batter of OT chains, Columbia Generating Station DG,
9 diesel generator, OT changes, South Texas Initiative
10 4(b), and the preliminary condition of Initiative
11 5(b). One I don't have there is the non-tech spec one
12 which is Surry, which I think is 5069 change.

13 Risk management 4(b) pilots on South
14 Texas, Fort Calhoun, Hope Creek. At the moment I
15 think we're going to get another one, but it's not yet
16 -- their proposal -- these three pilots unfortunately
17 at the moment are not standard tech spec plants, and
18 we're interested in getting a standard tech spec
19 plant. We think there might be one on the horizon,
20 but it's not yet.

21 DR. APOSTOLAKIS: Yeah. Are you reviewing
22 the EPRI interim report as a part of the --

23 MR. TJADER: Yes. That's the risk
24 management guidance document.

25 DR. APOSTOLAKIS: Yeah. What is the

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1 meaning of a quantitative/qualitative risk assessment?
2 And how does one use RG-1.200. to review a qualitative
3 risk assessment?

4 MR. REINHART: I'm not sure what you're --

5 DR. APOSTOLAKIS: Page 3-3, if you have it
6 with you, but you take my word for it. They use it.
7 They use those words.

8 MR. REINHART: I think that's one of the
9 things that's going to have -- in the 1.200 arena and
10 as the pilot goes I'm sure there's going to be some
11 places where we're going to say, "Well, what does this
12 mean? How do we do it?" And we need to clarify that.

13 DR. APOSTOLAKIS: And then it goes on and
14 says -- it's the top of the page -- "In addition, the
15 assessment may credit compensatory actions established
16 during the period being evaluated."

17 How does one do this?

18 MR. BOYCE: I don't want to directly
19 answer because I probably won't get it right, but what
20 I'll tell you is that where we are in the review of
21 this document, we did an acceptance review and
22 provided higher level comments, and then this document
23 is going to be resubmitted to us, and we'll do a more
24 detailed review of it.

25 DR. APOSTOLAKIS: So we will have another

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1 meeting at some point in the future.

2 MR. TJADER: Oh, for sure.

3 MR. BOYCE: Right, but I don't think we've
4 really engaged it at the level you're asking.

5 DR. APOSTOLAKIS: But you will at some
6 point.

7 MR. BOYCE: I certainly hope we do, and
8 I'm looking at the reviewers in the audience who I'm
9 counting on to do that.

10 MR. TJADER: In general, this is going to
11 be a PRA quantitative assessment. However, that is
12 impossible to perform necessarily 100 percent of the
13 time, and so there could be qualitative bounding
14 considerations for some inoperabilities and things
15 like that.

16 In other words, to the extent that it's
17 possible, there will be some all out qualitative
18 assessments.

19 With respect to the second part of that --
20 what was the second part of the question now?

21 DR. APOSTOLAKIS: The assessment.

22 DR. KRESS: Compensating actions.

23 DR. APOSTOLAKIS: Yeah, I mean, we're
24 making a big deal out of the quality of the PRA, and
25 then we're throwing a sentence like this there which

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1 opens up gates now to do whatever you like.

2 MR. REINHART: Maybe a high level answer
3 to your question is that based on our initial look at
4 that proposed risk management guidelines we think some
5 work needs to be done.

6 MR. BRADLEY: I just wanted to speak to
7 that briefly because I was somewhat familiar with why
8 the guide was written that way.

9 Biff Bradley, NEI.

10 Generally plants, even if they're using
11 quantitative methods, also are looking at qualitative
12 insights on top. I mean, they're not just taking a
13 risk metric. You're also looking at what are the
14 insights coming out of the PRA. It really wasn't
15 intended to say you can do this strictly
16 qualitatively, but there may be a blended method, you
17 know.

18 And with regard to compensatory measures,
19 some of those are quantifiable. Others are not. I
20 mean, you know, if you rope off the other train or
21 limit maintenance on the other train, then that pretty
22 much means you don't need to, you know, take your
23 averaged unavailability for the other train into
24 account.

25 On the other hand, if it's compensatory

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1 action, it's something like, you know, notifying
2 management or whatever. Obviously you can't quantify
3 that. So it depends on which measure you're taking
4 whether you can quantify the credit for it.

5 DR. APOSTOLAKIS: Well, there should be
6 some more detailed guidance.

7 MR. BRADLEY: Yeah, and I think as Tom
8 said, we're in the early stages of evolving that
9 guidance and ultimately there will be considerably
10 more detail on these types of things as we go through
11 the pilots and learn and incorporate that into the
12 document.

13 MR. REINHART: Hopefully the next revision
14 will be more detailed.

15 MR. TJADER: And then the pilots will test
16 these things that we're discussing about today. In
17 other words, quality, scope of PRA, configuration risk
18 management, and the process.

19 These are the big picture issues currently
20 reviewing, big picture review issues. Reliability,
21 the results are accurate. Repeatability, similar
22 plant configurations will result in similar completion
23 times. And it must be enforceable, and there must be
24 adequate oversight. Must have a quality PRA.

25 And that basically concludes my comments,

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1 and I think with respect to some of the detail, as far
2 as limits and cumulative risk and determining what the
3 AOT is, I know that in NEI and subsequent South Texas
4 ones there are specific graphs that will discuss some
5 of those details, and that might be the appropriate
6 time to address some of that.

7 DR. LEITCH: How do we prevent the abuse
8 of the system? For example, how do we prevent
9 licensees from selectively managing the maintenance or
10 the out-of-service time on certain systems so that
11 they're bumping into the backstop?

12 MR. TJADER: I think the cumulative risk
13 metrics that we come up with and goals that are
14 established for the plant, and plus existing
15 maintenance rule, availability, reliability goals for
16 equipment will be an incentive not to abuse the
17 system. I'm not exactly sure what abuse the system
18 is. You abuse the system and it seems to me that if
19 you attempt to abuse the system, you will run into
20 high risk levels and therefore short completion times,
21 and it will tell you you shouldn't do that.

22 DR. APOSTOLAKIS: Unless you take undue
23 credit for compensatory measures.

24 MR. TJADER: Well, as Biff just said, and
25 that was the other thing I wanted to say in the second

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1 part of that compensatory measures, they have to be
2 able to assess them quantitatively in the PRA or they
3 have to be strict restrictions on what other systems
4 or equipment cannot subsequently become inoperable.

5 It's not just, oh, I'm going to station a
6 fire watch and therefore I can go another five hours.
7 No, there has got to be definite quantitative
8 judgments on the completion times should be and if
9 there are other Tier 2 type requirements that are
10 determined in 1.177, such as systems which should not
11 be inoperable, that would then be a hard and fast
12 determination and require then the resulting shutdown
13 action or whatever, getting out of the operability of
14 the tech spec.

15 MR. REINHART: It might be good to go back
16 and look at the different time periods again. Real
17 time on a given configuration, the plant may be able
18 to go to a backstop, but on the evaluation period when
19 you look at the cumulative risk accumulated over the
20 year, if that plant has abused it, it's certainly
21 going to show up.

22 DR. KRESS: I don't think you ought to
23 view hitting the backstop as an abuse because it's
24 more of that for a defense in depth and actually, you
25 know, if you hit it and shut down, why, it's a good

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1 thing. I don't think you ought to view that as an
2 abuse.

3 DR. APOSTOLAKIS: That's not tan issue of
4 hitting the backstop. The issue is coming up with --
5 oh, yeah, you have the 30 days. Well, but you should
6 have done it in 20 hours, and you actually claim, you
7 know, 45 because you take dubious credit.

8 MR. KRESS: Yeah, I agree with you on the
9 compensatory.

10 MR. TJADER: And, you know, from our
11 standpoint, we want our goals to have the plant in the
12 full-up configuration to the fullest extent that we
13 can, and so I'm looking to rather than call it abuse,
14 we are looking for ways to incentivize the licensee to
15 get to that point.

16 The technical way we were talking about
17 doing it was using the cumulative risk metric. What
18 I'm concerned about is because cumulative risk can act
19 over such a long period of time, it may not be enough
20 of an incentive. Okay?

21 And so if you have a 30-day backstop that
22 you're allowed you may leave the equipment out of
23 service because you can't get a contractor on site
24 within a week. So, you know, you just let it
25 languish.

1 That's the scenario that is of my concern,
2 and so I would like to have some better way to
3 incentivize, something like as low as reasonably
4 achievable approach to risk, and it's something that
5 may come out of this pilot, is how best to do that.

6 I think an ALRA approach to risk makes a
7 lot of sense. Whether I can get rulemaking or not is
8 an entirely different question.

9 DR. LEITCH: It seems to me, too, that
10 there might be a distinction, a forced outage of a
11 system and a scheduled outage of a system. In other
12 words, what concerns me is like the HPSI system there.
13 You're talking about during that period of time a
14 voluntary decision to take a diesel out of service,
15 for example.

16 It seems to me it's a little different if
17 you're scheduling a diesel out of service versus a
18 diesel that breaks down, if that distinction is
19 recognized.

20 MR. BOYCE: Well, the Commission tried to
21 make a distinction for us in the SRM saying there's a
22 tradeoff between operational flexibility and PRA
23 quality, and like the 30 days, the reason we have that
24 backstop there is that's the most we can conceive of
25 for operational flexibility that you need to fix

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1 equipment in.

2 Typically we would expect it to be done
3 faster. So even within that 30 days of operational
4 flexibility we'd still like to incentivize if
5 possible.

6 So I think the Commission is trying to
7 tell us to make that kind of judgment if we can.

8 MR. TJADER: Well, it's certainly the most
9 we can conceive for plan maintenance.

10 Let me, if I could, invite Biff Bradley up
11 to do his presentation. I think what we ran into
12 unfortunately with the subcommittees and we're running
13 into here, too, is that unfortunately we're eating up
14 all of the time.

15 DR. APOSTOLAKIS: Okay. So shall we move
16 on?

17 CHAIRMAN BONACA: George, if you could end
18 at 20 of one, it would be helpful because this will
19 give us five minutes to go to the head before we get
20 Paperiello here.

21 DR. APOSTOLAKIS: Oh, we've got time for
22 him to come later.

23 CHAIRMAN BONACA: And then we have to have
24 lunch, too.

25 DR. APOSTOLAKIS: I think we are already

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1 into the details. So do we really need the foundation
2 and the objectives? I mean, it's up to you, Biff.
3 Jumping to Slide 4 or something, five. It's up to
4 you. It's up to you.

5 MR. BRADLEY: Okay. Thanks.

6 Let me go ahead. I'm Biff Bradley of NEI.
7 I also have at the table Wayne Harrison and Bill
8 Stillwell from STP, who is one of our pilot plants of
9 4(b).

10 In the interest of time I'll try not to
11 repeat anything that the NRC staff said, other than to
12 say I generally agree with most of the comments that
13 were made, and the areas that need additional work I
14 would agree.

15 DR. APOSTOLAKIS: You put the word "most"
16 as a defense in depth measure?

17 MR. BRADLEY: Yeah.

18 DR. APOSTOLAKIS: In case you disagree
19 with one, but you --

20 MR. BRADLEY: It's possible, but generally
21 speaking I'm in general agreement with the staff's
22 presentation.

23 Okay. The only comment I wanted to make
24 here is just all plants are required by regulation to
25 have a configuration control program right now, even

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1 though we have the existing tech specs. That's
2 (a) (4), the maintenance rule that went into effect in
3 late 1999.

4 All plants use PRA. All plants use their
5 internal events at power PRA as part of their (a) (4)
6 program.

7 We have a considerable amount of
8 experience doing this industry-wide already, and
9 basically what we're talking about here is increasing
10 the rigor of what we're doing as a tradeoff for
11 getting additional flexibility in the deterministic
12 tech specs.

13 I did want to mention also it came up
14 earlier. Industry is ready whenever ACRS is to come
15 in and give you a detailed technical presentation on
16 the tools that we're using, the safety monitors and
17 the other types of tools we're using to do this. This
18 came up at the subcommittee meeting, and EPRI has a
19 considerable amount of activity in this regard.

20 And just to reiterate, we have already
21 done some preparation for that and just need to have
22 a date set. We will be happy to come talk --

23 DR. APOSTOLAKIS: Are you talking about
24 the full committee or subcommittee?

25 MR. BRADLEY: Whatever is your desire. We

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1 can do either, but as much detail as you want. We're
2 ready when you are.

3 DR. APOSTOLAKIS: Okay.

4 MR. BRADLEY: On the objectives, just a
5 couple of things I wanted to mention. With regard to
6 the second bullet, one of the reasons we wanted to try
7 to preserve the front stops in the existing format and
8 content of tech specs was operators have been using
9 these documents for, you know, 20 or 30 years, and we
10 don't want to do something that just radically changes
11 what the operators in the control room are having to
12 deal with.

13 So there was an incentive there to try to
14 maintain the existing form of tech specs, but at the
15 same time allow this option to go to the configuration
16 risk management AOT.

17 Also, it's not one of our objectives to
18 either increase overall unavailability of systems or
19 plant risk through this program. All we're trying to
20 do is optimize the way we take equipment out of
21 service and get flexibility where currently we're
22 constrained by tech specs.

23 Over time this should not result in
24 increased unavailabilities. There are a number of
25 mechanisms out there that would preclude that, such as

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1 the other elements of the maintenance rule, the
2 oversight process, particularly if we go to MSPI where
3 you're having to track and maintain the availability
4 and the reliability of your key safety functions
5 systems.

6 So, again, it's not our intent to
7 generally change the risk profiles.

8 I think the staff touched on all of the
9 comments here. So I'll go on.

10 Pilot plants. We have South Texas here.
11 Additionally we have Hope Creek, which is a BWR; Fort
12 Calhoun, which is a small Westinghouse plant that's
13 doing the HPSI -- either the two or three loop; I
14 forget -- but they're doing the HPSI specific CEOG
15 method.

16 We also have a number -- for some reasons
17 we've got a lot of plants coming out of the woodwork
18 showing interest in being a pilot. We have two
19 additional plants that are seriously interested in
20 being a pilot. I guess at some point we're going to
21 have more pilots than we can work with here. So --

22 DR. APOSTOLAKIS: Can older plants be
23 pilots?

24 MR. BRADLEY: I don't think so. That's
25 NRC's decision as to how many pilots you can have, but

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1 there is certainly a lot of interest in this.

2 The risk management guidance as we
3 discussed is developed by EPRI, and it basically
4 builds on the existing (a) (4) guidance. That was our
5 starting point.

6 As we talked about earlier, there's much
7 work that remains to be done on this. We're not
8 trying to claim this is the final form of the
9 guidance. You mentioned a couple of areas where those
10 are the kinds of areas where we have to flesh out a
11 lot more detail in terms of things like credit for
12 compensatory measures or qualitative/quantitative
13 methods, blended methods, and how those could be used.

14 What we've discussed with the NRC staff is
15 taking the existing version of the guidance and moving
16 into the pilot phase and actually using the pilots to
17 flesh out the additional detail.

18 PRA scope and quality obviously important
19 for this initiative. Obviously internal events at
20 Power and LERF will be a 1.200. We envision it as the
21 capability Level 2 of the ASME standard as endorsed by
22 1.200.

23 We also believe you need to have a PRA for
24 external events, including seismic, as well as fire.

25 One challenge for this initiative is that

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1 standards for fire, in particular, are a couple of
2 years away, and then there's the time necessary for
3 NRC to endorse that through a subsequent revision to
4 Reg. Guide 1.200. So these plants are going to be
5 ahead of the curve with regard to fire and possibly
6 external events, and we will be in that box, the
7 infamous box where plants would theoretically get low
8 priority.

9 It was discussed that that won't happen
10 here, but this is a good example of why that low
11 priority thing doesn't always work.

12 Another thing, clearly you have to be able
13 to quantify configuration risk. That's what your
14 tool, your safety monitor, your pre-assessment
15 database, whatever you're using; you have to have that
16 capability, and that's going to have to be
17 demonstrated, and to some degree we'll have to work
18 with the NRC on the level of detail.

19 Another important aspect of this is the
20 ability to determine and track aggregate or cumulative
21 risk. Again, it's not our intent to increase risk
22 over time. So we have to have a threshold and some
23 trigger there to keep that from happening, and
24 obviously you'll have PRA updating requirements as
25 well.

1 Maybe STP will. I wasn't planning to
2 actually show any numbers here, but I did want to
3 discuss just in general the metrics that the EPRI
4 guidance will be using.

5 One issue is whether you need -- and we've
6 been through different versions of this so far, and I
7 don't know where we'll ultimately settle out, but one
8 question is do you need separate guidance for planned
9 maintenance versus emergent conditions. Should you
10 have a smaller window and then a little wider latitude
11 if you have an emergent condition?

12 DR. POWERS: Excuse me just a second.

13 MR. BRADLEY: Sure.

14 DR. POWERS: Steve, do you have to take
15 over? We have a conflict; we've got a problem. The
16 Chairman just walked out of the -- oh, George is
17 chairing. That's okay.

18 Sorry, George.

19 DR. APOSTOLAKIS: I'm -- okay.

20 MR. BRADLEY: There are three things that
21 we're looking at, and these are exactly the same
22 approach that's in the existing (a)(4) guidance. One
23 is the temporary risk increase, that is, the
24 integrated or the incremental core damage probability.
25 Of course, this will be the same for LERF, and that's

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1 the integral of the risk increase over time that you
2 have the equipment out of service.

3 Right now what we have in the (a)(4)
4 guidance, it allows you to have an ICDP of up to ten
5 to the minus five as long as you're incurring risk
6 management actions or whether we'll maintain that same
7 thing going into this remains to be seen.

8 DR. KRESS: That's each time you --

9 MR. BRADLEY: Yeah, for a specific
10 configuration, ICDP is limited to ten to the minus
11 five.

12 Now, obviously the question becomes how do
13 you define a configuration, and one way is the way STP
14 does it, which is to roll it up on a work week basis.

15 DR. KRESS: Is there any thought that
16 those guidance acceptance criteria should be different
17 for different plants?

18 MR. BRADLEY: Yes. I think it is possible
19 that one size will not fit all plants because of
20 significant differences in baseline risk values.

21 DR. KRESS: Yeah, yeah. So there is some
22 thinking along that line.

23 MR. BRADLEY: Yes, yes.

24 DR. APOSTOLAKIS: Also, again, the EPRI
25 document, two concepts that I don't know where they

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1 belong. One is that there will be a nice EDP of ten
2 to the minus six, and that will be a target value,
3 and then a ten to the minus five ICDP which will
4 define the maximum.

5 So which one are you referring to here?

6 MR. BRADLEY: Well, I think that comes
7 from the first bullet you're seeing here where you
8 would plan to a ten to the minus six ICDP, but for an
9 emergent condition you could go higher.

10 DR. APOSTOLAKIS: Oh, I see.

11 MR. BRADLEY: I think that's how those --

12 DR. APOSTOLAKIS: Aren't these numbers
13 very low? Ten to the minus six, for heaven's sakes,
14 is a way down there.

15 MR. BRADLEY: Well, an ICDP, for a
16 configuration it's not. It's not what I would call
17 really low. That's typically, you know, we're using
18 numbers in that range right now in (a) (4).

19 DR. APOSTOLAKIS: This would be the mean
20 value of something, I suppose.

21 MR. BRADLEY: Right. The second thing is
22 what we call the speed limit in this slide, but
23 basically that's if you were at the condition you're
24 at. If you were there for an entire year, what would
25 your CDF be, you know, and right now that's a ten to

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1 the minus three limit in the (a) (4) guidance.

2 And finally the cumulative risk. That's
3 the over time, over an operating cycle or year or what
4 have you. What is the delta risk that you've incurred
5 through this?

6 And the (a) (4) guidance right now states
7 that the permanent change criteria of 1.174 would be
8 used there. So that was the small change criteria of
9 1.174 is ten to the minus five. A very small change
10 is ten to the minus six. Again, we haven't gotten
11 into the down and dirty discussions with the numbers
12 yet with NRC, but this is generally how we have tried
13 to do it.

14 The other important aspect of this is
15 after you've assessed risk and determined what the
16 risk of the configuration is, it's how do you manage
17 the risk. You know, we talked about calling this risk
18 management tech specs. Well, the big, important
19 element of this is managing the risk, and there are
20 many ways that can be done, and I've just listed some
21 examples here.

22 One is take the existing action that's in
23 tech specs, if it's shut down or whatever.

24 A real important one is planning and
25 sequencing. For planned maintenance, obviously you

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1 want to plan your maintenance out so that you're not
2 incurring risk spikes or, you know, you want to do
3 that the smart way. That's really the whole point of
4 (a) (4).

5 You can train and pre-stage to speed up
6 maintenance activities and limit your time duration.
7 So that will also limit your risk; can provide for
8 rapid recovery; actually set the maintenance up so
9 that you can get the equipment back to functionality
10 quickly.

11 Another classic risk management thing is
12 to prohibit maintenance on the opposite train, and
13 then, of course, shut down the plant. That's the tech
14 spec, and one of the challenges for our risk
15 management guidance is factoring in, okay, when do you
16 shut down.

17 Right now the (a) (4) guidance says one of
18 the things you can consider is shutting down, but it
19 doesn't tie that to any threshold, and ultimately for
20 4(b), we may need to tie it to a threshold.

21 So finally, in conclusion, it says
22 challenging from the standpoint that it does clearly
23 require a high quality and a fairly full scope PRA,
24 and again, we're still working on the risk management
25 guidance. We want to flesh that out through the

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1 pilots.

2 And NRC wants this to be exportable, to
3 use Tom Boyce's phrase, to other plants beyond the
4 pilots. So their challenge is to what level of detail
5 do we capture all of this risk assessment and
6 management in the EPRI guidance and in the tech specs
7 itself to the point where we can export it to other
8 plants.

9 So unless there are any questions I'll go
10 ahead and turn it over to STP.

11 DR. APOSTOLAKIS: Go ahead, please. You
12 have quite a number of slides here.

13 MR. HARRISON: A lot of them are review
14 stuff that --

15 DR. APOSTOLAKIS: Can we do that in real
16 time or is it a predetermined? Predetermined?

17 MR. WAYNE HARRISON: Absolutely. Okay.
18 Let's go ahead and go to Slide -- well, I'll introduce
19 this.

20 I'm Wayne Harrison, South Texas project,
21 and Bill Stillwell from our PRA organization.

22 I'll go quickly over what our pilot
23 application is.

24 Next slide.

25 As we said, we're an industry pilot. I

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1 think the main thing I want to address here on this
2 slide is that we've been doing this for a while, and
3 the risk informed technical specifications, the
4 question was asked about what's risk management. We
5 looked at risk informed technical specifications as
6 one part of risk management.

7 We apply configuration risk to a number of
8 different things at STP, and this is just one aspect
9 of trying to safely operate, safely operating the
10 plant through risk management.

11 Okay. Next slide.

12 I think we've talked about all of those
13 between Biff and the NRC. So let's go ahead on the
14 next slide.

15 The scope and content of our technical
16 specification pilot application is shown here. These
17 are the components and functions that are covered in
18 what is a pretty broad scope application. I'd like to
19 point out that these are all covered and only covered
20 in most one through four. None of these are in the
21 shutdown modes of five and six.

22 And these were selected on the basis that
23 they're all quantified in our PRA so that we can use
24 the PRA to quantify the extended allowed outage time.
25 That's how we selected this population of technical

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1 specifications.

2 Next slide.

3 This is our draft technical specification
4 3.13.1. This is our corollary of the comparable
5 specification to what Bob Tjader showed on the
6 standard spec. We're not an ITS plant. So this is
7 what we were proposing, and each of those technical
8 specifications you saw listed on the previous slides
9 will have words that invoke technical specification
10 3.13.1.

11 Once we have determined that we're
12 planning to go beyond the what is called the front
13 stop time or what is the existing allowed outage time
14 for any system we could apply technical specific
15 3.13.1. Now, as the configuration changes, we have
16 the capability to requantify and reevaluate what the
17 allowed outage time would be and manage to that.

18 Once you invoke 3.13 or once you're
19 applying it for any technical specification, you would
20 continue to apply 3.13.1 until no technical
21 specification system is beyond its front stop time.
22 In other words, you're back into your existing allowed
23 outage time. Nothing is beyond its time.

24 Biff talked about when do you go to
25 shutdown. This one, if you look at the last action

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1 here, the way we've structured this is our criteria is
2 1E to the minus five incremental core damage
3 probability, and if we encounter a situation where we
4 are above that threshold, then we would declare the
5 action or the LCO not met for the technical
6 specification that put us here and take the required
7 actions of that technical specification, which would
8 likely include the shutdown.

9 So that's our hook at this point, and that
10 still, of course, will be under staff review. We plan
11 to submit this next month.

12 The next page is just a sample
13 specification. I'm not going to go through that in
14 any detail. I'm just going to use this as an
15 opportunity to introduce Bill and tell you that he's
16 going to talk about or touch on the PRA quality. We
17 understand that that's going to be discussed with ACRS
18 this afternoon.

19 But he's going to give you, I think, some
20 valuable insights into implementation. We already use
21 risk metrics, as I said, for managing our work weeks,
22 and we briefed our Operations Department, our
23 operators, our licensed operators on this risk
24 informed technical specifications. They're
25 enthusiastic about this. They're accustomed to

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1 working in this kind of environment, and they're
2 looking forward to using these.

3 So without any further discussion, I will
4 turn it over to the man who knows the real story here.

5 MR. STILLWELL: I hope.

6 My name is Bill Stillwell. I'm the PRA
7 supervisor at South Texas project.

8 Can we have the next slide, please?

9 DR. APOSTOLAKIS: No one is going to talk
10 about this?

11 MR. WAYNE HARRISON: That one?

12 DR. APOSTOLAKIS: Let's go to eight.

13 MR. WAYNE HARRISON: You want to go
14 through that?

15 DR. APOSTOLAKIS: Well, I'm trying to
16 understand B.

17 MR. WAYNE HARRISON: Okay. Let me. B is
18 an STP specific thing. Remember STP has three trains.
19 B is a new action for STP.

20 Right now this only -- by the way, this
21 only shows the LCO of this technical specification.
22 We're not proposing to do anything to the surveillance
23 requirements. So I'm not showing the surveillance
24 requirements.

25 But right now we only have action alpha in

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1 this technical specification for essential cooling
2 water. If we don't meet -- if we have more than one
3 train of essential cooling water inoperable, we're in
4 technical specification 303. However, because of the
5 redundancy in our system and the capability of our
6 systems, STP does not lose safety function with more
7 than one train of ECW inoperable.

8 So it's appropriate for us to have an
9 allowed outage time for more than one train of ECW
10 inoperable.

11 DR. APOSTOLAKIS: But is B the result of
12 an evaluation that involves the incremental core
13 damage probability or is it just a safety, I mean, a
14 deterministic thing. As you say, you know, we have
15 three trains. We can do it with one.

16 MR. WAYNE HARRISON: Right. There's two
17 answers to that. The answer to both those questions
18 is yes. The one hour time frame is deterministic
19 because right now that's consistent with the one hour
20 in 303. So we're not going to debate the staff on
21 what the allowed outage time should be for two trains.

22 DR. APOSTOLAKIS: So that's a front stop.

23 MR. WAYNE HARRISON: That's a front stop.

24 DR. APOSTOLAKIS: Okay. So where is the
25 risk informed?

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1 MR. WAYNE HARRISON: The risk informed
2 part would be within that one hour we can either
3 restore it or you see, we have the option to go apply
4 the requirements of technical specification 313, which
5 is this, and Bill --

6 DR. APOSTOLAKIS: Oh, 313 is a
7 quantification?

8 MR. WAYNE HARRISON: Right.

9 DR. APOSTOLAKIS: Okay, okay. Go ahead.

10 MR. WAYNE HARRISON: And determine what an
11 appropriate --

12 DR. APOSTOLAKIS: But where does it say
13 that? Where does it say go to three -- oh, yeah,
14 yeah, yeah, yeah. Okay. Go ahead.

15 MR. STILLWELL: Next slide.

16 Okay. I guess Reg. Guide 1.200 is going
17 to be discussed this afternoon. As part of the risk
18 informed technical specifications, we're also a pilot
19 on implementation of Reg. Guide 1.200. As part of
20 that, we are going to be making a submittal the middle
21 of August that will discuss how we feel that we
22 satisfy the requirements of the ASME standard and Reg.
23 Guide 1.200.

24 As I understand it, in October the NRC
25 will come and review the PRA quality, and at the end

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1 we will evaluate how well we think we did and how well
2 the NRC thinks we did and are there any recommended
3 changes to Reg. Guide 1.200.

4 At the same time we're going to define the
5 quality that's necessary in the PRA to support risk
6 informed technical specifications.

7 Everybody has mentioned that we've been
8 doing this. We've been doing this since 1996. We use
9 the program to satisfy the requirements of 10 CFR
10 5065(a)(4). In the program, we apply a non-risk
11 significant threshold of one times ten to the minus
12 six incremental core damage probability for our
13 maintenance week.

14 The program also has a higher limit, one
15 times ten to the minus five that's a potentially risk
16 significant threshold. These thresholds are the same
17 as those we were talking about for risk informed
18 technical specification. In a couple of slides, we'll
19 see what's the effect or what we have seen over the
20 past six years.

21 We've had extensive experience applying
22 the configuration risk management program. We
23 routinely use it to manage weekly work, and we've
24 effectively applied that process to a recent extended
25 diesel generator allowed outage that we'll talk about

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1 in a couple more slides.

2 I'm going to see if I can answer some of
3 the questions and concerns that came up in earlier
4 discussions. We are a precalculated configuration
5 risk management program. At the same time we're also
6 real time. It takes us eight minutes to do a
7 calculation to support a change in maintenance
8 configuration.

9 We have an on duty risk management person
10 that gets a phone call within 15 minutes. If a
11 configuration develops that's not covered by the
12 existing precalculated, we have almost consistently
13 gotten an answer back to the plant staff within an
14 hour, no matter what time of the day or night.

15 Backstop. Just for information, all of
16 our backstops are pre-analyzed on the system basis
17 already. That will be part of the submittal that
18 Wayne was talking about. In the submittal we looked
19 at individual component or train configurations and
20 all possible configurations on a system level. So we
21 would look at Train A, Train B, Train C, and all
22 combinations of those three.

23 The tool that we use and most tools that
24 I've seen, I have the capability to reprioritizes and
25 return to service. Arturo (phonetic) will give you a

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1 ranked list of components to return to service saying,
2 "Do this for the biggest bang, this other one, and
3 finally this last one."

4 You had a question on Reg. Guide 1.177 and
5 whether this would be a 1.177. My opinion, and it's
6 my opinion, Reg. Guide 1.177 would be used if we
7 wanted to change a front stop limit rather than a pre-
8 analyzed configuration. So Reg. Guide 1.177, the
9 submitted would say apparently we have seven days to
10 the front stop. We want to go to 14 days as a front
11 stop. That would be Reg. Guide 1.177.

12 DR. APOSTOLAKIS: Any permanent change.

13 MR. STILLWELL: That would be a permanent
14 change. These are not permanent changes.

15 DR. APOSTOLAKIS: Well, if they're
16 predetermined though.

17 MR. STILLWELL: They're not permanent.
18 We're only going to be there for a limited amount of
19 time. We just happened to calculate a large number
20 of --

21 DR. APOSTOLAKIS: What do you mean by
22 "permanent"? Permanent means for the rest of the
23 licensing basis.

24 MR. WAYNE HARRISON: I think what you find
25 though is that the number of times that you will

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1 actually go in and apply risk informed technical
2 specifications will be relatively uncommon per time
3 per year. It's not like every time I --

4 DR. APOSTOLAKIS: No. I think the way I
5 see, you know, the subcommittee we had didn't really
6 go into details, right? It was a fairly high level
7 overview of what's going on, and I think when we take
8 up Mr. Bradley's offer and maybe organize another
9 meeting where we're actually going into details like
10 this, because we really don't have time today to get
11 into that and the quality issues and this and that.

12 I really like Slide 11. How many
13 utilities have done this? How many utilities have
14 considered zero maintenance CDF and then added the CDF
15 due to on-line maintenance?

16 I mean, this is a very interesting slide.
17 It's not to scale, I hope.

18 MR. STILLWELL: It's not to scale.

19 DR. APOSTOLAKIS: Okay. Bill, what do you
20 want to tell us about this?

21 MR. STILLWELL: Basically this is an
22 example of one of the presentations the operators
23 give. As we change the configuration, you'll see that
24 we actually will present the speed limit, as it were.
25 What is the absolute change of core damage frequency

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1 if you assume you're going to be here for a year?

2 So that would be equivalent to the ten to
3 the minus three that's proposed.

4 CHAIRMAN BONACA: So the limit is what,
5 two?

6 MR. STILLWELL: Two is, in this case, two
7 times the face cord and frequency.

8 CHAIRMAN BONACA: I'm sorry? I didn't
9 hear you. If you could speak.

10 MR. STILLWELL: The two is normalized.
11 It's normalized to --

12 CHAIRMAN BONACA: So it's not a limit.

13 MR. STILLWELL: It's not a limit.

14 CHAIRMAN BONACA: Okay. The limit would
15 be the lower.

16 MR. STILLWELL: The limit in terms of this
17 scale would actually be higher.

18 CHAIRMAN BONACA: Higher?

19 MR. STILLWELL: In terms of the limit is
20 ten to the minus three. That would be a factor of 100
21 for us.

22 CHAIRMAN BONACA: Wow.

23 DR. APOSTOLAKIS: No, no, no, no, no.
24 Okay. So this is a time history, I suppose.

25 MR. STILLWELL: Right. This would be a

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1 time history for an average maintenance week, as an
2 example.

3 DR. APOSTOLAKIS: Okay.

4 MR. STILLWELL: And this is one
5 presentation tool that the operators have.

6 CHAIRMAN BONACA: You said the factor of
7 100?

8 DR. APOSTOLAKIS: Yeah, because they're a
9 very low CDF.

10 MR. STILLWELL: Our baseline core damage
11 frequency is --

12 DR. APOSTOLAKIS: Three ring.

13 CHAIRMAN BONACA: I don't quite
14 understand.

15 DR. APOSTOLAKIS: No, he didn't say that
16 they were going to go a factor of 100, but the speed
17 limit, if it were ten to the minus three, it's about
18 a factor of 100.

19 MR. STILLWELL: You couldn't stay there
20 long, you know, because you're going to hit your other
21 metrics. You other metrics are going to quickly
22 become controlling if you spend much time up in that
23 vicinity.

24 DR. APOSTOLAKIS: In fact, on 13 you have
25 the CDF, right? Slide 13. Look at that.

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1 MR. STILLWELL: Let's go to Slide 13 if
2 you can.

3 DR. APOSTOLAKIS: You see, it's on the
4 order of ten to the minus five.

5 MR. STILLWELL: This is six years' worth
6 of history of South Texas Project. Both units
7 represented, and you'll see that maintenance actually
8 goes up and down throughout the year for the plant.
9 These are cumulative annual. So the '04 is weekly,
10 and we track it on an annual basis. Annual core
11 damage frequency modified week by week.

12 MR. BRADLEY: Is that the diesel outage on
13 the --

14 MR. STILLWELL: The far right is the
15 diesel outage that we just completed. We've been
16 doing this since 1996.

17 The ten to the minus five average annual
18 core damage frequency is actually based on our current
19 model. It's not the average of the lines. So we
20 calculate an average based on our current PRA and then
21 it has just dropped down slightly. So the blue line
22 is actually not an average.

23 CHAIRMAN BONACA: Now, you said that spike
24 is due to the diesel outage? You don't have their own
25 tech specs, or it allowed to take one out? You have

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1 three diesels?

2 MR. STILLWELL: We have three diesels.

3 CHAIRMAN BONACA: So you do have an
4 ability to take it out even before you have this
5 implemented.

6 DR. APOSTOLAKIS: I would be careful here
7 using the word "spike." I mean, look at the scale.

8 CHAIRMAN BONACA: I understand that.

9 DR. APOSTOLAKIS: One, point, two; one,
10 point, four.

11 CHAIRMAN BONACA: Yeah, but the spike gets
12 back to the thread.

13 MR. REINHART: If it was a log scale you
14 wouldn't even see it.

15 DR. APOSTOLAKIS: Yeah.

16 CHAIRMAN BONACA: He mentioned it. He
17 used the word "spike," and that's why I referred to
18 that.

19 DR. APOSTOLAKIS: I know, but Bill --

20 MR. STILLWELL: I'll clarify it.

21 DR. APOSTOLAKIS: -- I know him very well.

22 MR. REINHART: This is Mark Reinhart.

23 When you asked about that diesel outage,
24 Mario, South Texas came in for an amendment request to
25 have a one-time extension to do that.

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1 CHAIRMAN BONACA: Okay.

2 MR. REINHART: So they used the 4(a)
3 approach, but on an one-time extension.

4 MR. STILLWELL: And we'll talk about that
5 in the last two slides.

6 DR. APOSTOLAKIS: Looking at the clock,
7 you really have to wrap it up. So tell us what is the
8 most important thing you wanted to tell us.

9 MR. STILLWELL: The most important thing.
10 We have been doing this for six years.

11 DR. APOSTOLAKIS: Right.

12 MR. STILLWELL: We have been controlling
13 maintenance in accordance with the limits that we're
14 trying to establish or that we're working toward in
15 the EPRI and NRC code. The intended one is ten to the
16 minus six.

17 In the course of the six-year history, we
18 have exceeded the ten to the minus six limit two
19 times.

20 DR. APOSTOLAKIS: That's interesting.
21 That's it?

22 MR. STILLWELL: That's basically it.

23 DR. APOSTOLAKIS: Well, gentlemen, I have
24 to apologize for cutting short your presentations, but
25 we will do what Biff offered in one of these months.

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1 I guess you are coming to Washington quite a lot.

2 MR. STILLWELL: Right.

3 DR. APOSTOLAKIS: We're going to have a
4 more detailed presentation. Maybe at some point when
5 the staff will have had the chance to review that EPRI
6 document and have detailed comments and so on, then it
7 would be appropriate perhaps.

8 When do you think? What time frame are we
9 talking about? The fall?

10 MR. BOYCE: Probably.

11 DR. APOSTOLAKIS: Probably the answer was.

12 MR. BRADLEY: We can certainly support
13 that.

14 DR. APOSTOLAKIS: No, I know you can, but
15 the staff. I would like the staff to have reviewed,
16 to have had some time to review it.

17 MR. BOYCE: Yeah, I'd like to say the
18 fall. As I understand, the submittal is going to come
19 in next month. What we probably need to do is
20 actually do a site visit, and we need to engage some
21 of our inspection oversight type of people.

22 DR. APOSTOLAKIS: Okay.

23 MR. BOYCE: Because that's where we think
24 the risk management guide really needs some of that
25 inspection experience. So if the schedule holds, the

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1 fall would be pretty --

2 DR. APOSTOLAKIS: Maybe in the October-
3 November time frame we can have a day subcommittee
4 meeting.

5 MR. BOYCE: All right.

6 DR. APOSTOLAKIS: Very good. Well, do you
7 gentlemen want to say anything else as a parting
8 remark? Biff.

9 MR. BRADLEY: I think not. We've had a
10 positive, constructive working relationship with NRC
11 staff on this, and we hope to continue it, and we
12 recognize it's probably a multi-year thing to get this
13 in place. It's not a simple thing, but there's a lot
14 of enthusiasm for this effort, and I think now that we
15 have PRA standards and Commission direction on scope,
16 I think it enables these kinds of things in a better
17 way than we would have had in the past.

18 DR. APOSTOLAKIS: Very good. Back to you,
19 Mr. Chairman.

20 CHAIRMAN BONACA: Thank you.

21 That was informative and a good
22 presentation.

23 We will recess now until 1:45, and --

24 DR. APOSTOLAKIS: Two minutes?

25 CHAIRMAN BONACA: What?

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1 DR. APOSTOLAKIS: Oh, 1:45.

2 CHAIRMAN BONACA: I said 1:45.

3 (Laughter.)

4 DR. POWERS: He's a PRA type. He came
5 within an order of magnitude.

6 CHAIRMAN BONACA: So we don't need to be
7 on record until 1:45.

8 (Whereupon, at 12:41 p.m., the meeting was
9 recessed for lunch, to reconvene at 1:45 p.m, the same
10 day.)

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AFTERNOON SESSION

(1:59 p.m.)

CHAIRMAN BONACA: We're back into session.

And now we have on the agenda Reg. Guide 1.200 and SRP 19.1, and Professor Apostolakis.

DR. APOSTOLAKIS: Okay. We wrote a letter in September of 2003, in which we recommended that Regulatory Guide 1.200 be issued for trial use with a number of pilot plants. So the staff is here today to brief us on the status and findings so far from the five pilots, I believe.

So Ms. Drouin.

MS. DROUIN: Okay. Thank you.

I'm Mary Drouin from the Office of Research, and with me is Donald Haroldson from the NRR.

Just one quick correction. We haven't actually started any pilots. So we don't have any lessons learned at this point. So we're going to try and give you a status of where we are and what lessons we hope to learn from implementation of the pilot.

DR. SHACK: What lessons you should have learned.

DR. APOSTOLAKIS: Have you selected the pilots?

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1 MS. DROUIN: Yes, yes. So we're going to
2 get into that.

3 Okay. The first viewgraph.

4 Okay. So we're here just to inform you
5 about where we are today, what the current activities
6 are, what the pilots are going to be, the schedule for
7 the pilots, what the actual applications for each of
8 the pilots are. We're going to walk through that
9 today.

10 I'll give you a little bit of background,
11 go back over to remind you what were the objectives of
12 the regulatory guide, the purpose of the pilots, what
13 is the scope of the pilot applications with our staff
14 review. This is a very important item here that
15 Donnie will get into, and the schedules, and
16 ultimately our conclusions.

17 Go ahead.

18 Okay. If you remember, back in April, I
19 believe, of 2002, ASME published the standard for
20 Level 1 internal events, full power, also including a
21 limited Level 2 LERF. They also ultimately came out
22 with an addendum about almost a year after that
23 because there was a lot of interchange with ASME and
24 the public in terms of our endorsement in the
25 objections that we took in our draft guide of 1.200.

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1 And we came to resolution on most of the
2 objections. There are still some clarifications that
3 we hope to resolve during the pilots.

4 Also there's NEI 0002, which is the PRA
5 peer review process guidance that we have up there
6 that most of the utilities have used. It's really
7 much better than most. It's all of them except San
8 Onofre have used this guide.

9 Also, in Regulatory Guide 1.200, we give
10 our staff position on what NEI calls the self-
11 assessment process where they have gone through the
12 peer review criteria and compared it to the ASME
13 standard and identified where there's discrepancies,
14 where they're the same, and then for the discrepancies
15 of the differences, they have some guidance, some
16 self-assessment that the licensee has to do to bring
17 themselves up to the standard.

18 In some of those we agree that the
19 criteria was the same as the standard, but in some
20 places we don't feel the peer review adequately
21 addressed the standard, and so those we hope to also
22 work out during the pilots.

23 SONGS did do a peer review, but it was
24 following the ASME standard, and a lot of lessons came
25 out of that. We actually made changes to Reg. Guide

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1 1.200 based on some of those lessons learned. And we
2 hope to work through more of those during the pilots.

3 Then we had a consensus plus, you know,
4 the letter from your committee that said move forward;
5 implement this for trial use for the pilots, which is
6 where we're starting out. We're putting together the
7 guidance for the staff reviews and scheduling out the
8 pilots.

9 Next one, please.

10 Going back through and just reminding
11 again what were the objectives of, you know, the
12 regulatory guide, basically it's to address the
13 question of PRA quality; that when we look at risk
14 informed activities do we have the confidence in these
15 base PRAs, the insights and the results that are being
16 lifted from them in the decision making process. Do
17 we have confidence in those?

18 DR. POWERS: Mary, I'm seeing your
19 struggling enormously again to remember how it is that
20 we declare a PRA to be adequate. I know that we can
21 certainly look and see if the scope is sufficient, and
22 we can certainly look at the databases that have been
23 employed.

24 But how do we know that it's adequate?
25 For instance, if it comes back and says, "Well, the

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1 reliability of this system is such that it fails ten
2 to the minus third times per demand," and the system
3 in question fails. We don't know anything, do we?

4 MS. DROUIN: I guess I don't understand
5 your question because I would answer your question
6 with another question. How do you know that you have
7 any confidence in any engineering analysis, that it's
8 adequate enough to support the application?

9 So my question is why is this question
10 being -- it looks like you're asking it unique to PRA.

11 DR. POWERS: If I do an engineering
12 analysis and it says that the member will stand up
13 here and support the train that runs over it, and if
14 the train runs over it and it doesn't support it, then
15 I know it was inadequate.

16 MS. DROUIN: Well, that's one way.

17 DR. POWERS: I mean a lot of these things
18 you've got pretty good proof one way or another. If
19 I predict that two things are going to react together
20 and put them together and they don't react, my
21 analysis was not adequate.

22 And so I'm struggling here to know how do
23 I know when a PRA is adequate or are we in this
24 situation that Professor Apostolakis decried so
25 eloquently that all we can adjudge is process, that we

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1 really can't judge product.

2 MS. DROUIN: I think personally that you
3 can judge the product because we're not in a situation
4 where we don't have any operational experience, and I
5 think that when you go back and you look at your
6 operational history of the plants, and you look at the
7 data there and look at it in comparison to what your
8 PRA has said, they aren't saying different things.

9 And I think those two together --

10 DR. POWERS: Yeah, but I mean that's --
11 the difficulty I have with --

12 MS. DROUIN: That's not any different than
13 your train scenario.

14 DR. POWERS: Well, the trouble is that
15 when I do deterministic analysis, I'm saying yes or
16 no. When you give me your probabilistic estimate, if
17 I ask you, in particular, you as an individual for the
18 probabilistic assessment, you're knowledgeable enough
19 that you're not going to give me a point value.
20 You're going to give me a distribution, and then when
21 I go and compare it against the data, the changes are
22 it's a fair probability that it's consistent with the
23 data.

24 MR. DONNIE HARRISON: And if it's not
25 consistent with the data, that tells you something

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1 also.

2 DR. POWERS: Then you've got an answer.
3 I mean, she's right about that.

4 MR. DONNIE HARRISON: Right.

5 DR. POWERS: I mean, the point was right.
6 I'm just trying to think of the practicality of it.
7 Do I ever come up with an answer or do I always come
8 up with I can't -- I suspect I can only conclude that
9 it's not inconsistent with the data is what I come up
10 with most of the time, which is actually a pretty good
11 conclusion.

12 MS. DROUIN: Yeah.

13 DR. POWERS: Okay.

14 MR. PARRY: Excuse me. Can I maybe add
15 something here?

16 This is Gareth Parry from the staff.

17 I think in this context the assessment of
18 whether a PRA is adequate is really more related to
19 whether it conforms to good industry practice. I
20 don't think we can --

21 DR. POWERS: I mean, that's George's
22 process evaluation, and sometimes you get stuck there.

23 MR. PARRY: And there's the additional
24 element of this that there will be a peer review also
25 as part of this assessment. So in a sense it's

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1 whether it's in conformance with what your peers think
2 is good practice.

3 DR. POWERS: Well, suppose that I'm
4 Professor Wallis for a second and I worry enormously
5 about the feelings and sentiments of Shakespearean
6 scholars who know little or nothing about PRA, but
7 they said these people have done this analysis and
8 they're knowledgeable people and whatnot, and they
9 declared it adequate, but I can't understand the thing
10 they produced, and I can't understand the peer review,
11 and I can't understand the assessment demonstrate to
12 this poor Shakespearean scholar that it's, in fact,
13 adequate.

14 And what Mary says is, well, you can't do
15 it on the CDF, but you can look at the component data,
16 the second tier of data that go in this and compare
17 the predictions and whatnot against what you observe,
18 and you get a conclusion that by and large is it's not
19 inconsistent with the data; is that right?

20 MR. PARRY: At that level, yes.

21 DR. POWERS: One of the things I worry
22 about enormously is the nuclear PRA community is of
23 finite scope. They all know each other. They all go
24 to the same conferences. They all sing from the same
25 textbook, and they can all delude themselves in the

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1 same way.

2 MR. PARRY: This is true of any analysis
3 that can't be directly --

4 DR. POWERS: Compared against it?

5 MS. DROUIN: Well, I hope we're smarter
6 than that. I like to think we are, but maybe I'm
7 deluding myself.

8 DR. POWERS: Oh, the capacity for the
9 profession to delude itself is enormous. I mean, look
10 what's been going on in stress corrosion cracking for
11 the last 50 years.

12 (Laughter.)

13 MS. DROUIN: Well, why don't we go ahead
14 and go to the next slide and get into the staff
15 reviews? And at this point I'm going to turn the
16 presentation over to Donnie.

17 MR. DONNIE HARRISON: I think as you all
18 are aware, under the current way we review risk
19 informed license and actions, there's a heavy reliance
20 on the knowledge and expertise or experience of the
21 reviewer to make sure he's looking at the right things
22 and tracking to find where the problems are to deal
23 with in the license application.

24 And during that, there is also a reliance
25 on prior reviews, the peer reviews the industry has

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1 done, the IPE, IPEEE, the research reviews of those
2 IPEs and IPEEEs, and then prior applications by that
3 licensee.

4 Those all kind of feed into how the staff
5 reviews a current risk informed licensing action.
6 There's not much guidance beyond that.

7 As well, there's not that much guidance
8 for what is expected of a licensee to submit to show
9 that they've got PRA technical adequacy. So that's
10 also part of the point of needing these standards and
11 needing this implementation trial phase.

12 Go ahead.

13 DR. POWERS: You're looking at this reg.
14 guide and whatnot, and the industry has this peer
15 review that they swear by, and it's being widely used.
16 I mean, just about everybody is using it and using it
17 repeatedly. Every time they refine the PRA they do it
18 a little more detailed or another application and they
19 go through another peer review and get this
20 assessment.

21 Which one is controlling? Is the reg.
22 guide to be? I mean, your standards that you're
23 setting up are to be kind of the minimum, and the peer
24 review process that the industry has set up goes
25 beyond that where it can.

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1 Do you have any idea?

2 MS. DROUIN: I'm not sure I still follow
3 your question when you talk about minimum. The
4 standard does have a minimum in it, but when it comes
5 down to looking at the peer review, you know, you're
6 going to have to do it in concert with the
7 application. So what you need for that application
8 may not be the minimum or what we would call Category
9 1.

10 MR. DONNIE HARRISON: And the peer review
11 itself may actually, if you follow the NEI guidance,
12 you may get a range for different areas, different
13 grades, and so it doesn't necessarily give you a
14 minimum or a maximum. It gives you a score, if you
15 will, for each of the different areas, and then you
16 have to look at those areas in the context of the
17 decision you're trying to make and say is that area
18 important and is it influencing the decision I'm
19 trying to make.

20 And if it's not, then you can tolerate, if
21 you will, a lower quality analysis or maybe even a
22 bounding analysis in that area. Whereas if it's
23 important, you may want to say, no, I've got to have
24 a good analysis here to be able to buy off on this
25 decision.

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1 So it's highly dependent, and I don't
2 think a peer review establishes a minimum. Like Mary
3 has said, I think that the standard actually has three
4 levels, and --

5 DR. POWERS: Which I'll transparently
6 admit that I've quite understood, but that's okay.

7 MR. DONNIE HARRISON: That's fair.

8 DR. POWERS: This is not the forum to try
9 to explain it to me.

10 MR. DONNIE HARRISON: And believe me, I
11 wouldn't try to explain it. One of the things that I
12 think we're trying to do in this trial phase is look
13 at the standard and look at the reg. guide and see if
14 we stumble over problems, interpretations, and
15 especially things that go across levels.

16 Is it really true that, you know, some of
17 these areas truly go across capability categories or
18 are there some of them that you should have a
19 demarcation that distinguish one level of quality from
20 another within a certain area?

21 But that's part of the pilot. That's part
22 of what we're trying to do.

23 DR. POWERS: One of the things that the
24 rotations in the regulatory field worry about is the
25 distinction between compliance with a regulation and

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1 self-policing; that when you create a standard with a
2 regulation, people come up and meet that standard, and
3 there's no incentive really to go beyond that.

4 Whereas without a standard and putting
5 reliance on this peer review process that's employed
6 to decide whether something is qualified creates an
7 incentive for innovation and improvement. Have you
8 thought about that?

9 MS. DROUIN: I agree that the peer review
10 is a mechanism for creating innovation because as you
11 look at things, you learn more. You find out, oh,
12 well, it wasn't quite the way I thought it was or you
13 think of a better idea or you notice something is
14 wrong or whatever.

15 I think using a peer review as a mechanism
16 to determine what you have done, how you've gone about
17 doing it meets the intent of what you wanted, is an
18 efficient way to go. It has its disadvantages, but I
19 think it has more advantages to it than disadvantages.

20 DR. ROSEN: Having seen one fairly close
21 up, I can say that it creates a lot of peer pressure
22 to improve. That's a partial answer.

23 MR. DONNIE HARRISON: And I think if you
24 look at some of the experience during the peer
25 reviews, there were cases where licensees in the early

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1 phases of this process thought they had good PRAs.
2 The peer review came in and actually kind of surprised
3 them with lower grades than they expected, which put
4 the licensee into, if you will, a fairly aggressive --

5 DR. ROSEN: Walking around smug and
6 complacent, and they come in and you end up with 72
7 action items.

8 MR. DONNIE HARRISON: Right.

9 DR. ROSEN: Holy mackerel.

10 MR. DONNIE HARRISON: And I think what
11 that did at least for a couple of licensees is it kind
12 of woke them up and made them go off and actually end
13 up with a second peer review because they wanted to
14 show that they were actually not as bad as they
15 thought they were good, and they wanted to get that
16 finding.

17 So I think the peer review process if done
18 correctly can do that, and it brings the whole
19 industry up by doing that, recognizing there's flaws
20 in the process whenever you do that.

21 If we can move on to the purpose of the
22 pilot, there's listed here about six different items.
23 The first one is just saying that there's things
24 within the reg. guide and the SRP that make
25 observations or clarifications to the ASME standard.

1 There were some things where if you will I guess I
2 would characterize them as disagreements between the
3 standard writers and the staff when it comes to the
4 term "significant" and how you define "significant."

5 And so we want to use this pilot to get at
6 that, and we want to look at the interpretations of
7 the requirements and see if we both, us and the
8 industry interpret things the same way.

9 And then there was a question early on
10 about documentation needs. I know in a meeting we had
11 in November of last year with the industry they
12 pointed out that the reg. guide in its documentation
13 section could be misinterpreted in some places, and if
14 you will, I'll count that as a lesson learned. We
15 corrected that before we published the reg. guide. So
16 we took that feedback in the November time frame and
17 changed the documentation section of Reg. Guide 1.200
18 so that it was a little clearer for the industry to
19 understand.

20 Some of the other things that we're trying
21 to do here is we're trying to assess the licensee
22 self-assessment process to see how effective that is.
23 This is the self-assessment they do between the NEI
24 002 review and the ASME standard. So they have to
25 look at the difference between those two things.

1 They did a peer review. Now they've got
2 a standard and they need to bridge the gap. So we
3 want to look at that and see how they do that. It's
4 an opportunity to look at the scope and level of
5 detail, the licensee application specific submittals
6 and the scope and level of detail of our reviews.

7 Part of the efficiency that is expected
8 out of the standard is that we will have more
9 efficient reviews and more focused reviews, and they
10 won't have to go as detailed in certain areas. So
11 that's a hope. That's one you pursue.

12 In the process of doing this, I'm sure
13 we'll identify things that need to be changed or
14 revised or clarified within the reg. guide, within the
15 standard review plan, even in the standard, the ASME
16 standard or the self-assessment guidance that NEI has
17 developed.

18 We're also going to gain some insights
19 into how many resources, how much effort is involved
20 in doing one of these reviews, and I think the
21 licensees are going to learn a great deal of how much
22 does it take to develop a license application that
23 meets the standard, that meets the reg. guide.

24 And then these insights that we gain
25 during this pilot I think will be helpful in the

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1 development of the other standards and how we handle
2 those and implement those. So the ones on fire,
3 external events, low power and shutdown that follow,
4 we'll learn from that.

5 Okay. Now, the scope of the pilots.
6 There's five pilots. The first one that's coming in
7 is Columbia. It's a risk informed tech spec. They're
8 doing a diesel generator AOT. They call it a loud
9 completion time extension. Its intent is to extend
10 the allowed completion time to 14 days, as long as
11 they've established some risk management actions, what
12 we'll refer to as compensatory measures.

13 The way their tech spec is laid out,
14 during the first 72 hours, which is their traditional
15 time, they have to put these compensatory measures in
16 place and have them ready, and after they do that,
17 then they can extend the outage to a 14-day outage.
18 Otherwise they have to follow the way they do things
19 now.

20 DR. POWERS: On this particular piloting,
21 they will, of course, have an extensive seismic PRA?

22 MR. DONNIE HARRISON: No, no. The scope
23 of this pilot -- maybe that's in my next slide or one
24 of my earlier ones. Yeah, we'll just jump to there --
25 the pilots are actual risk informed submittals. Okay?

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1 So we have to write an SE that talks about the
2 submittal, to approve the submittal of which a small
3 piece of which is PRA quality for technical adequacy,
4 but the pilot is only focused on the standard that we
5 have endorsed in Reg. Guide 1.200, and that standard
6 is a full power Level 1 PRA plus LERF.

7 The other aspects, the external events,
8 lower power shutdown will still be reviewed as part of
9 the application, but it will be reviewed like we
10 review applications today, because we don't have an
11 endorsed standard that's been approved and issued in
12 the reg. guide.

13 DR. POWERS: I mean, if somehow a plant
14 within 200 miles of Mount St. Helen's, it strikes me
15 as one that seismic can be a fairly important
16 determiner and how long it can have its emergency
17 diesel generators out.

18 MR. DONNIE HARRISON: I'm sure that will
19 be a topic as part of the review. I'm just saying
20 that it's not part of the pilot. So that issue will
21 have to, just like lower power and shutdown, has to be
22 dealt with just like fires has to be dealt with.

23 So you're right. You have to deal with
24 it. It's just that it's not within the scope of the
25 pilot. It's in the scope of the application.

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1 And one of the points I have on here is
2 when we have the future standards are developed and
3 endorsed, then I would expect we would go through that
4 process, a pilot process or something like that as
5 well, where we would test them out or could do that,
6 but at this stage we don't have that. So we're doing
7 what we have with what we have.

8 The other aspect, and I'll just hit on
9 this while this slide is up here, is that because
10 these are pilots and we're trying to exercise the
11 entire standard, use the entire reg. guide even
12 though, for example, Columbia is a diesel generator
13 AOT extension, we are going to look at things that are
14 unrelated to that application that are in the PRA
15 standard.

16 So the SE will be on the standard, but the
17 pilot will actually go beyond the application because
18 we want to exercise the full breadth of the reg.
19 guide.

20 DR. ROSEN: I assume the people who are
21 submitting this understand that.

22 MR. DONNIE HARRISON: They understand that
23 very well, and if I'm incorrect, Biff will correct me.

24 MS. DROUIN: Let's put it this way. We
25 tried to make it clear, and we have verbalized it

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1 numerous times.

2 DR. ROSEN: Maybe they'll listen.

3 MR. DONNIE HARRISON: Well, as an
4 observation, I think I would say we've already seen
5 one lesson is as licensees have gone out to develop
6 the documentation to support PRA quality or technical
7 adequacy, they're seeing it as a -- I think they're
8 coming to realize it's a bigger thing to do than they
9 thought originally. It's taking longer to develop the
10 submittal and to do the evaluations than they
11 originally thought.

12 So one of the reasons why we haven't got
13 moving too fast on this to start with is because the
14 submittals have not yet shown up. That's going to
15 change next week.

16 Limerick is a risk informed tech spec.
17 It's a 5(b) initiative. This is where they're moving
18 the surveillance test intervals to a licensee control
19 document. I just put on here that they're not moving
20 surveillance requirements. The test intervals are
21 going to be based on a risk informed process. So it's
22 a process review.

23 SONGS will be coming in a risk informed
24 tech spec as part of a batter replacement, and they're
25 going to reconfigure their DC power system. What it's

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1 going to try to do is to allow an on-line cross-tab of
2 DC subsystem within a train for up to 30 days for
3 maintenance and replacement of the batteries.

4 DR. ROSEN: A temporary change, not a
5 permanent change, right?

6 MR. DONNIE HARRISON: The battery
7 replacement is temporary, but the tech spec will be
8 permanent. This will be --

9 DR. ROSEN: The tech spec will be
10 permanent, but you said they're going to reconfigure
11 their system.

12 MR. DONNIE HARRISON: They're going to
13 reconfigure it permanently.

14 DR. ROSEN: That reconfiguration is
15 permanent?

16 MR. DONNIE HARRISON: That's a permanent
17 reconfiguration. What they're doing is they have four
18 batteries, and the way the tech specs are laid out,
19 they want to split them in the trains so you'll have
20 an A train and a B train with two batteries each, and
21 they're going to gain, again, the idea of being a
22 three-day AOT because they can take a battery out and
23 still have train DC.

24 DR. ROSEN: Well, they're making a design
25 change under a pilot of a reg. guide?

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1 MR. DONNIE HARRISON: Well, no. Again,
2 this is a real application, a risk informed
3 application. So we're going to do a safety evaluation
4 of that application. It's just that it's a piloting
5 of the aspect of the PRA technical adequacy.

6 DR. ROSEN: Okay. So you're going to do
7 a safety evaluation for the change. It's going to be
8 judged against Reg. Guide 1.174.

9 MR. DONNIE HARRISON: Right.

10 DR. ROSEN: In terms of delta CDF?

11 MR. DONNIE HARRISON: Right, and --

12 DR. ROSEN: For a permanent change.

13 MR. DONNIE HARRISON: For a permanent
14 change.

15 DR. ROSEN: Okay, I guess.

16 MR. DONNIE HARRISON: And, again, that's
17 the point of all of these. These are all license
18 applications. I would say the only one that is
19 probably pseudo not a license application is the next
20 one, surry, which is a 10 CFR 5069 application. We
21 don't have the rule yet. So it's hard for them to
22 have a license application. They're piloting the
23 industry guidance on 5069. And hopefully once the
24 rule goes out it would be a fairly quick turnover if
25 they had done this and we've accepted it to actually

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1 implement it then.

2 DR. ROSEN: And what's the scope of their
3 5069 application?

4 MR. DONNIE HARRISON: It's only for a
5 couple of systems, but within 5069, if I can regress,
6 it's a process review. So even though they may only
7 do it for a couple of systems --

8 DR. ROSEN: It's a process.

9 MR. DONNIE HARRISON: -- we're approving
10 the process. Once the rule goes out, it would be a
11 process approval. So the systems are just to
12 demonstrate how the process works.

13 DR. ROSEN: But they would still have to
14 comply with the rule when the rule would come out.

15 MR. DONNIE HARRISON: Right, right. You
16 would have to send in a license amendment.

17 MR. DONNIE HARRISON: Right, exactly, a
18 license amendment. We would review the license.
19 Again, I would assume if we're part of the pilot, at
20 least on PRA on technical we'll be ahead of the game
21 when that pilot comes in.

22 And the last one you heard this morning at
23 least briefly from South Texas, their 4(b) initiative.
24 So that's the five applications we're actually looking
25 at.

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1 I'll skip that one.

2 I put this slide in here because I think
3 we needed to understand some of the -- when we're
4 trying to schedule these pilots, some of the things we
5 had to think about, trying to do this within a one-
6 year period, and as we move along we're kind of doing
7 it in about seven months.

8 We have been having regular meetings and
9 we plan to continue to have those meetings. We've
10 held two general public meetings with the industry and
11 the pilots. We've also had for the first three
12 applicants, we've had individual meetings with them to
13 talk about their application and in that context talk
14 about PRA technical adequacy within that context.

15 We plan to continue to hold regular
16 meetings about every couple of months while the pilots
17 are going on so that we can feed back lessons learned
18 to the other pilot applicants, and they can feed us
19 what they're getting out of this as well.

20 The second bullet just recognizes we're
21 doing multiple -- there's multiple licensees involved.
22 We're doing different kinds of applications. We're
23 using multiple staff reviewers, and we need to make
24 sure we get efficiencies in those reviews such that we
25 don't end up affecting all the other work that we have

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1 to do.

2 So there's other risk informed licensing
3 actions and rulemaking that's going on, and we need to
4 make sure those things aren't impacted during this
5 process.

6 And as much as possible, because of all
7 that, the trial application reviews are going to
8 overlap. So we're going to gain efficiencies from one
9 review and move it to the next and just have an
10 overlapping process going on.

11 And as an example, here's the near term
12 schedule for the pilots. Like I said, next week we
13 expect to get an application from Columbia. I think
14 by the end of May right now at least we're supposed to
15 be getting something from SONGS and Limerick. We're
16 going to go out to Columbia the week of June 7th.
17 We're supposed to get a trial application submitted
18 from Surry. I think that's been postponed, that one,
19 as I heard this morning, that it's been postponed a
20 few months.

21 The status meeting we'll hold at the end
22 of June to go over what we learned during the Columbia
23 visit. I think Columbia is going to be a good trial
24 for everyone. It will help the staff to go out on a
25 visit to learn about how they conducted the visit and

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1 what maybe to change in future visits to do these
2 reviews.

3 The week of July 12th we're supposed to go
4 to Limerick. The week of August 9th, we're going to
5 go to SONGS. At the end of August we're supposed to
6 get the application or some time in August; I think
7 it's mid-August actually we're going to get an
8 application from South Texas for the 4(b) initiative.

9 DR. ROSEN: Go down there. It's a lovely
10 time in South Texas.

11 MR. DONNIE HARRISON: Well, we're planning
12 actually not to go there until October, see.

13 MS. DROUIN: At the earliest.

14 MR. DONNIE HARRISON: At the earliest,
15 yeah. Mary is in control of that schedule.

16 MS. DROUIN: And as somebody who was born
17 and raised in Houston, I know you don't go down there
18 before October.

19 MR. DONNIE HARRISON: And then we plan on
20 having another status meeting at the end of August.

21 DR. POWERS: You've got to suffer when you
22 work for the NRC, and you've got to love it.

23 MR. DONNIE HARRISON: And in this case we
24 can kind of control our own destiny.

25 And the last one I'll leave off her and

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1 pass on to Mary. Appendix C of Reg. Guide 1.200 was
2 to be issued by the end of August, and that appendix
3 is for the external events, ANS external events
4 standard. So with that I'll pass on to Mary.

5 MS. DROUIN: Yeah, I just want to go over
6 the overall schedule of 1.200 because as we look to
7 next year of when we're going to publish it as Rev. 1,
8 you know, there's other parts to 1.200 than just
9 Appendix A and Appendix B.

10 We do have Appendix C, which will have our
11 endorsement of the standard. That standard came out.
12 We're in the midst of reviewing it. We've gotten
13 various comments from the different offices in the
14 agency and comments from the regions. So we're
15 pulling together our staff comments right now and
16 trying to sort through them.

17 We hope to go through some public meetings
18 through the summer and discuss it and then finally go
19 with formal public review and comment by the end of
20 August on Appendix C.

21 Go through that process so that ultimately
22 as we go through the pilots we are looking to have all
23 of our lessons learned from the pilots by December,
24 the end of December.

25 That doesn't mean that we would wait till

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1 the end of December to start modifying the reg. guide.
2 You know, as we learn something we'll do it, but to
3 try and have all of our lessons learned and our
4 changes made to the reg. guide by the end of December
5 so that we would go out on public review and comment
6 for Rev. 1.

7 So what I'm saying is we're doing two
8 public review and comment periods, one in August, but
9 that will just be on Appendix C of the reg. guide, and
10 then we will go back out on public review and comment
11 on the entire reg. guide in January with issuing it at
12 the end of April. So in between there, you see, I
13 have some question marks there for ACRS. We were
14 thinking of coming back to the ACRS in November of
15 this year where we would talk both on the external
16 events and also what lessons learned we've had on the
17 pilots to that date.

18 Then go out for public comment I said in
19 January. We would ultimately want to come back to the
20 ACRS in March because in order to issue Rev. 1 of the
21 reg. guide we will need a letter from the ACRS
22 approving that publication.

23 We'd also have to go to CRGR also in that
24 time period, and we've interspersed public meetings
25 through the process.

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1 So I kind of jumped around in trying to
2 explain the schedule, but there it is. Now, Donnie,
3 do you want to wrap up?

4 MR. DONNIE HARRISON: Yeah, I'll do the
5 first two and you can do the last two.

6 MS. DROUIN: Oh, okay.

7 MR. DONNIE HARRISON: I'll make a point
8 before we conclude though. Again, the focus here is
9 on the PRA technical adequacy guide. So in these
10 applications when they come in, conceivably our source
11 of the pilot is broader than the application. So we
12 could find PRA technical adequacy issues that may have
13 nothing to do with the application, and we would
14 identify those, but it wouldn't stop the application.
15 So the application may still be approved even with
16 that, in that situation.

17 Likewise, you could have an application
18 not succeed for deterministic review reasons, and yet
19 the PRA technical adequacy part of it would move
20 forward. So that's just a recognition of what can
21 happen in the process.

22 And just to conclude, we're just now
23 embarking on the trial implementation phase really,
24 and it's going to involve some actual license risk
25 informed applications.

1 MS. DROUIN: And as I said earlier, you
2 know, we have a lot of things that we're looking
3 toward in the pilots to help us on some outstanding
4 issues to revise in the reg. guide. Donnie mentioned
5 probably the most significant one is coming to a
6 determination of what should be the definition of the
7 term "significant."

8 And then just looking at, you know, how
9 are these requirements being interpreted. Hopefully
10 there will be some resolution on places where we still
11 have objection. I mean, my personal goal is I'd love
12 to have an appendix that says no objections so as we
13 can resolve all of these and come to an agreement on
14 them, it would be ideal.

15 I'm also hoping that as we go through
16 these pilots that we get some good lessons learned
17 that will really help us as we implement the next set
18 of standards. You know, this has been a very
19 challenging piece of work to do, and hopefully we
20 aren't going to repeat some of the same mistakes and
21 make the process a lot more efficient as we endorse
22 and implement the external events and as we go into,
23 you know the internal fires and low power shutdown,
24 that those will go a lot smoother from what we've been
25 through on the ASME standard.

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1 DR. ROSEN: What do you think about the
2 idea that the term "significant," the context around
3 it, that something is significant if it would impact
4 the decision making process. If it's not going to
5 change the decision or have an impact on the decision
6 making process for the context, it's not significant.

7 What do you think about that?

8 MS. DROUIN: That is one explanation you
9 could use, but I think that can be difficult to use
10 that kind of definition when you're getting into a
11 requirement that says, you know, "Don't do this. Only
12 do this for your significant ones."

13 How you write that into the standard when
14 you don't know the application.

15 DR. ROSEN: It's only good after the fact.
16 It's not good as an a priori.

17 MS. DROUIN: Yeah. But you know, it could
18 be that as we go through the pilots that we become
19 creative enough to write something of that order. I
20 mean, I don't know. I mean, I feel as though it has
21 to be quantitative, but we're certainly open to try
22 and find a qualitative definition.

23 DR. ROSEN: Well, see, something like that
24 would be consistent with the history of development of
25 the standards. It has always been application driven.

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1 You know, here's how good a PRA you need to do this,
2 not just how good a PRA you need, period. Because you
3 don't need a PRA at all.

4 MS. DROUIN: I wouldn't agree that when we
5 wrote the standard that it was application driven. I
6 mean, when you decided to write what the requirements
7 are, for example, on your systems analysis or your
8 initiating event, we certainly didn't think, "Oh,
9 we'll write this requirement because of this
10 application."

11 We wrote the requirement because that was
12 needed to achieve the objective of that technical
13 element.

14 MR. DONNIE HARRISON: But if I can maybe
15 agree with you, there's two different things going on
16 here. There's things that are significant to a
17 decision and then things that are significant within
18 an analysis.

19 The problem we have is we're using the
20 analysis and making a decision, and if you separate
21 the two, then you end up with different definitions of
22 what's significant. You have to have different
23 definitions because you don't know the application,
24 and that's part of it. It's not a problem, but it's
25 part of the issue with the word "significant" within

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1 the PRA technical ASME standard. It's just what is a
2 good PRA, and what are the elements that it has to
3 have.

4 DR. APOSTOLAKIS: Well, we are a
5 regulatory agency. I mean, we make regulations.

6 MR. DONNIE HARRISON: Right.

7 DR. APOSTOLAKIS: So that ultimately has
8 to support regulatory decision making.

9 MR. DONNIE HARRISON: Exactly. I agree
10 with you. It's just that within the context of
11 writing what does a PRA need to have, you would write
12 one thing, and then how you use it in making a
13 decision is different.

14 DR. ROSEN: Right. I know. I'm not so
15 sure that that's separable. You know, I could hold a
16 good tennis racket in my hand, and you could look at
17 it and say, "That's a pretty good tennis racket," with
18 the thought that you have in your head that I'm going
19 to use it to play tennis.

20 But if my intention is to go hit Noland
21 Ryan's fast ball, it's probably not good enough.

22 MR. DONNIE HARRISON: I agree, but what
23 you would say in that case is that that is quality
24 tennis racket. Its implementation is not good, but
25 yeah, I can agree with you.

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1 DR. ROSEN: I'm not convinced of that. I
2 think it's context driven.

3 MR. DONNIE HARRISON: Fair enough.

4 DR. APOSTOLAKIS: Are you done with this?

5 MR. DONNIE HARRISON: Yes.

6 DR. APOSTOLAKIS: So any discussion?

7 That's what it says here, and it also says
8 that Donnie would do that.

9 (Laughter.)

10 MR. DONNIE HARRISON: I'll do a forum.
11 Everything is wonderful. The staff is doing great.

12 (Laughter.)

13 MR. DONNIE HARRISON: They all need
14 bonuses.

15 MS. DROUIN: I like that part.

16 DR. SHACK: Okay. We'll add to your work
17 load.

18 DR. APOSTOLAKIS: You don't know where
19 you're starting?

20 DR. SIEBER: He's starting from scratch.

21 MR. BRADLEY: I don't have a presentation.
22 I'm going to be quick. I'm going to get you guys back
23 on schedule today, hopefully.

24 We have the five pilots that have put a
25 tremendous effort into this project. This is an

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1 important effort for the industry. We spent over five
2 years developing the ASME internal events at power PRS
3 standard; spent nearly two years working on the reg.
4 guide to endorse it, and I think that speaks to the
5 challenge of trying to write a standard for PRA.

6 And now we're at the most important part
7 of all of that, and that is taking that and taking it
8 out of the office building and putting it out in the
9 field somewhere and trying to make it work out in the
10 plant.

11 And I guess it's safe to say there's some
12 trepidation about this. We now have hundreds of PRA
13 requirements, the level of detail, and the need for a
14 more systematic consideration of every element of the
15 PRA is evident, and we expect this to be a fundamental
16 change to the way applications in the past have been
17 performed and reviewed.

18 So we don't see this as a minor change.
19 This is really a step change in the regulatory process
20 and in the evolution of getting risk methods into
21 regulatory space.

22 The Commission wrote an SRM to the staff
23 on PRA scope and quality, and this is the first step
24 of moving in the direction of that SRM going into the
25 Phase 2, as the staff calls it, of the implementation,

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1 and it's not a baby step. this first step is a big,
2 three foot step we've got to get over. The internal
3 events at power is the -- all of the PRAs are
4 important, but this is the central one, the most
5 important.

6 So I think so far this has gone well.
7 We've had good interactions. I think we understand
8 where we are, what our expectations are for each
9 other, and the plants have certainly put a huge effort
10 into this. The plants do not want this to fail. They
11 do not want this standard to become a reason for
12 protracted reviews or problems. We all want this to
13 succeed.

14 The ASME standard and the Reg. Guide 1.200
15 do set a high bar, capability Level 2. What's evolved
16 is a PRA described there. There is really no plant
17 that the U.S. currently has, but it can be achieved.
18 Much of that is in the area of documentation, and it's
19 reasonable to expect you should have good
20 documentation.

21 The plants that have -- the pilots that
22 have been working on this have put in some cases, you
23 know, man-years into documentation, trying to come up
24 to the standard.

25 You know, despite the fact there is some

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1 trepidation about this, I think at the same time we
2 all hope that this will enable more significant
3 applications. I think applications like 5069 probably
4 just wouldn't have been feasible absent standards.
5 We all recognize we need standards to move forward.

6 There are issues of interpretation in the
7 standard. I was at the San Onofre peer review, as
8 were some here, and plants have interpreted elements
9 of the standard differently.

10 The real interpretation that matters is
11 what is NRC's interpretation. What is the regulatory
12 expectation? That is the only interpretation that the
13 vast majority of plants out there care about, and
14 that's what's going to emerge from this pilot process.

15 Right now we have a standard, you know,
16 but at the end of this process, we're going to have a
17 much better understanding of what is the expectation
18 for that requirement. What does the regulator think
19 that you have to do to meet that?

20 And that's what we'll get out of this.
21 We're going to have to communicate this to the
22 industry at large before the reg. guide becomes final
23 next year because at that point this will apply to
24 every application and every plant going forward, and
25 so we have a major communications job once we're done

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1 with these pilots, taking everything we've learned and
2 getting it out into the rest of the plants.

3 So I think that's pretty much all I have
4 to say. As Donnie said, the real rubber meets the
5 road starting next week when we get the Columbia 200
6 page on the docket application, and we hop that's just
7 a pilot thing and that doesn't set a precedent for
8 what every plant will have to do forever. Certainly
9 I don't think we want that.

10 But we recognize the pilots are going to
11 have to have more submitted, and that's just what's on
12 the docket. We have archival documentation that
13 probably exceeds that by an order of magnitude or
14 more.

15 So, again, you know, this isn't a minor
16 thing, and so far so good, but the real part is just
17 now starting. So it should be an interesting the rest
18 of the year. We're going to be really busy.

19 It's a very aggressive schedule for the
20 plants and for NRC to get through these five pilots
21 over the next year.

22 Any questions?

23 (No response.)

24 DR. APOSTOLAKIS: Okay. Thank you very
25 much, Biff.

1 MR. BRADLEY: Sure.

2 DR. APOSTOLAKIS: Well, Mr. Chairman,
3 we're back to almost ahead of schedule.

4 CHAIRMAN BONACA: You are very valiant.

5 DR. APOSTOLAKIS: I run this with an iron
6 hand, I'll tell you.

7 CHAIRMAN BONACA: You pressure these
8 people so hard.

9 DR. KRESS: Valiant.

10 DR. POWERS: There wasn't enough interest
11 to actually have this session is what you're trying to
12 say.

13 CHAIRMAN BONACA: Well, I think we have 25
14 minutes before --

15 DR. KRESS: Sort of like stress corrosion.

16 CHAIRMAN BONACA: -- our break. So we'll
17 do two things. One, we'll take the break, longer than
18 normal.

19 Let me just before we -- first of all, I
20 think we should go off the record until the next
21 presentation, which comes at 3:30.

22 Second, I would like to just make a head
23 count of the reports that we can work on tonight.

24 (Whereupon, the foregoing matter went off
25 the record at 2:50 p.m. and went back on

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1 the record at 3:28 p.m.)

2 CHAIRMAN BONACA: We are back into
3 session.

4 And the next item on the agenda is good
5 practices for implementing human reliability analysis,
6 and Dr. Apostolakis.

7 DR. POWERS: What is this, the Apostolakis
8 day?

9 DR. APOSTOLAKIS: Yeah.

10 CHAIRMAN BONACA: Yeah, today is his day,
11 although --

12 DR. POWERS: My didn't you assign him MOX
13 and then he could have a clean sweep.

14 CHAIRMAN BONACA: That's a good idea.

15 DR. APOSTOLAKIS: We had the subcommittee
16 meeting where we discussed the good practices
17 document, and we also had another presentations, but
18 today we will just talk about the or we'll hear from
19 the staff on these good practices document. It is
20 supposed to be a general document, not tied to a
21 particular model for human reliability analysis, and
22 eventually it will be part of Regulatory Guide 1.200,
23 right?

24 MS. LOIS: Supporting regulatory --

25 DR. APOSTOLAKIS: Supporting acceptable

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1 approaches for determining the technical adequacy of
2 PRA. So --

3 DR. SHACK: Another appendix?

4 DR. APOSTOLAKIS: Another appendix.

5 DR. SIEBER: This will be Appendix K.

6 MS. LOIS: I don't think it will be an
7 appendix to regulatory. It will be a supporting
8 document.

9 DR. APOSTOLAKIS: A supporting document?

10 MS. LOIS: On how to perform human
11 reliability.

12 DR. APOSTOLAKIS: Okay. So we can start
13 with Dr. Lois, I guess.

14 MS. LOIS: Thank you.

15 Good afternoon. My name is Erasmia Lois.
16 I work for the Office of Research, Probabilistic Risk
17 Assessment Branch.

18 And with me today is John Forester of
19 Sandia Laboratories, and Alan Kolaczowski will not be
20 able to be with us today physically. However, he is
21 available through the phone. He is the primary
22 developer of the good practices.

23 Also I would like to recognize the
24 contributions of Gareth Parry, who recommended to do
25 the good practices document, and he has been helping

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1 out with working closely with Gareth and Alan in
2 general.

3 And Susan Cooper, who is not with us
4 today, but she is also part of the staff.

5 What we'll do today, I thought it would be
6 good if I provide a broad overview of the HRA
7 activities so that the committee recalls what we're
8 doing there, and then as Dr. Apostolakis said, discuss
9 in detail the HRA good practices.

10 We intend to release it for public review
11 and comment in July, and we would like the committee
12 approve and agree with and go ahead and release the
13 document.

14 DR. APOSTOLAKIS: So you are requesting a
15 letter.

16 MS. LOIS: We are requesting a letter.

17 In general, what issues we tried to
18 address by the HRA research program, the first issue
19 is the HRA implementation. As a matter of fact, this
20 HRA quality issues, PRA/HRA quality is an important
21 activity at the NRC, and as part of that, we're also
22 putting our efforts, but also we have developmental
23 activities. Later development is one area that we're
24 focusing a lot.

25 The NRC has new needs. For example,

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1 applications for materials and waste or new reactors,
2 therefore. We're focusing on expanding or developing
3 new knowledge base for human reliability, and also
4 we're addressing specific regulatory issues.

5 And the next chart is a viewgraph, you
6 know, graphic representation of our activities. The
7 HRA guidance reference documents are on the bottom.
8 this is probably the bulk of our research program
9 currently.

10 However, we're also, as I said, developing
11 data. Data is one of the important limitations of the
12 HRA state of the art. HRA state of the art has not
13 matured at the level of detail, has not reached the
14 level of maturity or some other areas in PRA.
15 Probably the primary limitation comes from the fact
16 that we don't have exact data in terms of number of
17 failures versus the number of demands.

18 What we tried to do here is collect
19 information that exists regarding human performance
20 and develop methods that would help us use the less
21 accurate data, but informative data.

22 We are developing a repository which we
23 call HERA, and currently we're focusing on populating
24 the repository with licensee reports, operational
25 experience and simulator experience, and in the future

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1 we'll try to expand to open psychological literature
2 and non-nuclear experience.

3 In terms of methods, I'm highlighting
4 ATHEANA. We have a small effort in making ATHEANA
5 implementation more user friendly, addressing serious
6 concerns on ATHEANA being cumbersome and, therefore,
7 not easily to be used by non-ATHEANA experts.

8 I mentioned the Bayesian quantification of
9 rushes (phonetic) that go hand in hand with the data
10 development. We do plan in the future to review other
11 second generation methods like MERMOS and CREAM for
12 the purposes of taking advantage of what they have in
13 terms of modeling human performance, and if we're
14 going to develop a third generation human reliability
15 analysis method.

16 As I mentioned, we have to expand our
17 knowledge base for human reliability, and these are
18 some of the things. The bullets here represent some
19 of the activities.

20 The less yellow color indicates that these
21 are more future activities than current activities,
22 but the human reliability research program is planning
23 to address related conditions, true performers, ex
24 control room reactions, slowly evolving events that
25 describe the advanced reactor work, and also low bar

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1 (phonetic) shutdown operations, and severe accidents,
2 the steam generator tube rupture PRA will force us or
3 is forcing us to address that.

4 DR. ROSEN: So you left the bullet off ex
5 control room actions then.

6 MS. LOIS: Yes, I did.

7 DR. ROSEN: Okay. That's not crew
8 performance somehow. There are five bullets under
9 that.

10 MS. LOIS: It's five bullets.

11 DR. ROSEN: Now, what I'm surprised and I
12 don't see anything of is organizational issues. When
13 you think about the future.

14 MS. LOIS: We went to the Commission with
15 a request to allow us to go back to organization
16 factors and organizational issues. We haven't had the
17 approval yet.

18 In actuality we cannot address this issue
19 yet.

20 DR. ROSEN: In what?

21 MS. LOIS: The Commission --

22 DR. ROSEN: Yeah, I heard the first part.

23 MS. LOIS: -- must tell us, must allow us
24 to address the issue.

25 DR. APOSTOLAKIS: Because it has

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1 explicitly disallowed you?

2 MS. LOIS: Explicitly stopped the work
3 about ten years ago.

4 DR. ROSEN: So you have a current request
5 into the Commission to allow you to begin in the
6 context of human factors analysis or human analysis --

7 MS. LOIS: Human cycles, human
8 performance.

9 DR. ROSEN: -- yeah, to consider the --
10 it's like a fisherman who knows everything about fish
11 and knows nothing about the ocean to do human factors
12 without knowing anything about the organization in
13 which the fish swim.

14 So to me it's important to be -- you know,
15 it's not something you're going to do overnight. It's
16 just something you begin to consider. You understand
17 the literature. You understand what's going on and
18 you begin to get into that horrible issue of safety
19 culture.

20 But I really think that it's just unwise
21 to close our eyes to this

22 MS. LOIS: In actuality we do believe that
23 the Commission will let this go ahead. We think in
24 preparation, I guess, since a year ago due to Davis-
25 Besse and other higher priority activities. Jay

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1 Persensky has the lead, and I think NRR has the lead
2 for it.

3 The EDO had some comments, came back to
4 the staff, and we were not able to address the EDO's
5 comments to go to the Commission. So there are two
6 things.

7 One is the staff was not able to bring it
8 back to the Commission, and the Commission was not
9 able to -- and, therefore, we don't have the go-ahead
10 yet.

11 However, I do want to remind the committee
12 that in the early '90s or mid-'90s we were doing a lot
13 of work in organizational factors, and we do have two
14 NUREGS ready to go out to be published, and that
15 represents a lot of work in the area. It isn't that
16 we haven't done a lot, and that work is really
17 current.

18 In terms of actual applications, the good
19 practices and the HRA method review addressed
20 primarily licensing issues, Reg. Guide 1.174 types of
21 licensee applications.

22 We are developing to the extent we can --
23 we use HRA insights to support various activities. An
24 example her is the fire manual actions. We tried to
25 address in ACRS recommendations. We tried to provide

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1 human reliability insights and reliability framework
2 in that activity, but again, as I mentioned, the HRA
3 guidance is an activity that we're going to talk about
4 today.

5 And again, to provide a broad perspective,
6 the HRA guidance consists of three documents.
7 Document one would be kind of a publication, a high
8 level summary of the HRA state of the art, and we plan
9 to have it ready to December, and document two is the
10 one that we're going to talk about today, and we would
11 like to go to public review in July and finalize it by
12 December.

13 And then we're going to, starting in
14 January, we'll start developing -- evaluating first
15 and second generation methods with respect to the good
16 practices.

17 Within that review we'll try to encompass
18 HRA methods that have not been developed in the United
19 States. However, licensees may use it, and that
20 includes MERMOS, CREAM, et cetera. So it will be a
21 broader review than just --

22 DR. APOSTOLAKIS: But why does it take so
23 long, Erasmia? December '06. And you guys go to
24 workshops. You listen to each other. Why should it
25 take two years?

1 MS. LOIS: It will take at least one year.
2 These are many methods. It will take at least one
3 year to have a good draft, and then come to you,
4 having the peer review, incorporate public comments.
5 This is going to be at least -- I envision that this
6 is going to be much more voluminous, much bigger
7 document than the HRA good practices.

8 Now, as you remember a comment we made at
9 the subcommittee meeting was that the good practices
10 document should be viewed by the principles of other
11 methods, and rather than doing things in the reverse
12 order here, should we have this document first,
13 evaluating what's out there before we write the good
14 practices document?

15 MS. LOIS: As a matter of fact, that's how
16 we started out. We started out looking at -- we
17 started out evaluating the existing methods with
18 respect to Reg. Guide 1.174 applications, and we
19 started saying, "This is good. This is not good," et
20 cetera, and then we figured it out, good or not good
21 with respect to what, your opinion or my opinion?

22 So the good practices in a way is the
23 standard, is the agreement among the HRA practitioners
24 that, yes, these are the principles for the employment
25 of good HRA. Once we agree, as you had mentioned in

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1 the subcommittee meeting, you recommended a broader
2 review than domestic review, and we are going to do
3 that.

4 So incorporating the comments from the
5 more general HRA-PRA community then we will have an
6 agreement that these are good practices, and then we
7 will be able to evaluate the various methods with
8 respect to -- I think it's --

9 DR. APOSTOLAKIS: Well, it could be the
10 other way.

11 MS. LOIS: -- to what extent the various
12 methods can meet or cannot handle the --

13 DR. APOSTOLAKIS: By the way, as you know,
14 there was a special issue with the journal with the
15 papers from the Munich workshop. Were you there at
16 the Munich workshop?

17 MS. LOIS: I was not. I was not part of
18 it.

19 DR. APOSTOLAKIS: But one of the papers by
20 Strata (phonetic) and others, with a title on "The Way
21 to Assess Errors of Commission," does, in fact, some
22 of these things in different context. What is
23 interesting is that they give a categorization of the
24 existing methods, and there are three categories:
25 task and activity related approaches, condition

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1 related approaches, which I think is ATHEANA, is the
2 context issue, and cognition related approaches, which
3 is I think somebody else's.

4 So there is a lot here in this paper.
5 Again, the motivation is different. It's how do we
6 collect data, and they say in order to collect data,
7 you have to have some idea of it, but a lot of what
8 they're saying here is really very relevant to this
9 issue of what kinds of models are out there, and then
10 the next that would be good practices and so on.

11 And I was very pleased to see this. There
12 is no American quoted though for some reason.

13 MS. LOIS: Well, all of --

14 DR. APOSTOLAKIS: Unless it says ATHEANA
15 you guys don't participate.

16 MR. FORESTER: John Forester, Sandia Labs.

17 I was at the Munich meeting, and so I'm
18 familiar with it.

19 DR. APOSTOLAKIS: Yes, but you're not an
20 author.

21 MR. FORESTER: No, I'm not an author on
22 your paper, no, but we've talked a lot.

23 DR. APOSTOLAKIS: Well, I think you get
24 credit at the end.

25 No, but what I'm saying is that people

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1 have already started thinking about this, you know.
2 What are the common elements. There's a figure here
3 that has the top -- in fact, the top part of the
4 figure is exactly what you're trying to do, and then
5 they're saying, "Now, here is another model which is
6 ATHEANA, how it handles these things." So it's very
7 useful, very useful. I mean, we didn't have the
8 resources.

9 MS. LOIS: One clarification is that the
10 good practices address current state of the art. I
11 mean, we've talked a little bit about that in the
12 subcommittee. To the extent that, yes, we look at the
13 errors of commission as beyond the state of the art,
14 but probably what you recommend here, it would be like
15 probably the next step, third generation methods where
16 we would sit back and we'd go and we'd review
17 everybody else's method in a collegial way we'd
18 develop the method that encompasses the good aspects
19 of --

20 DR. APOSTOLAKIS: Yeah, but that's for the
21 future.

22 MS. LOIS: Yes.

23 DR. APOSTOLAKIS: I mean, for this
24 particular document, I recommend that you have a peer
25 review right away.

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1 MS. LOIS: Yes.

2 DR. APOSTOLAKIS: Yeah.

3 MS. LOIS: But I doubt that those ideas
4 will get into this document.

5 DR. APOSTOLAKIS: Well, I mean, there is
6 a group of methods that is related to cognition. Now,
7 those guys may tell you, well, it's a good practice to
8 worry about ABC, and then you decide whether it, in
9 fact, would be a good practice.

10 Because this document now is really very
11 much influenced by ATHEANA, which is not surprising,
12 you know, but --

13 MS. LOIS: You mean the current version.

14 DR. APOSTOLAKIS: Yeah, the current
15 version. So getting some input from those people.
16 Are you going to talk at all about the plan? You said
17 you are planning to have this peer review, or this is
18 it?

19 MS. LOIS: This is it. I think John is
20 going to --

21 DR. APOSTOLAKIS: So this PRA review will
22 take place --

23 MS. LOIS: In July.

24 DR. APOSTOLAKIS: -- in parallel with the
25 public comment period.

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1 MS. LOIS: That's right. As part of the
2 public comment period we will request non-domestic
3 entities that are recognized in the HRA area --

4 DR. APOSTOLAKIS: Why not also domestic?

5 MS. LOIS: Domestic is given.

6 DR. APOSTOLAKIS: Oh, I see. Okay. So it
7 would be a formal peer group or you will them
8 individually?

9 MS. LOIS: We have to think about
10 individually. You just recommended and we haven't
11 thought about it, but we plan to do that.

12 DR. APOSTOLAKIS: Okay.

13 MS. LOIS: Okay. With that I will ask
14 John Forester to do the presentation.

15 DR. APOSTOLAKIS: Although, just a last
16 comment. When we talk about cognitive models, it's
17 worthwhile to repeat what Dr. Kress said at the end of
18 the subcommittee meeting. Throw everything that is
19 related to the operator's mind out of the report.

20 DR. KRESS: I did.

21 DR. APOSTOLAKIS: That's going to be the
22 advice. He doesn't want to get into anybody's mind.

23 MR. FORESTER: I'd like to first address
24 the issue that's been underlying the work we're doing.
25 As you know, PRA/HRA is being used. It's being used

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1 to assess risk associated with current operating
2 conditions, for example, pressurized thermal shock, as
3 Erasmus mentioned, possibly steam generator tube
4 rupture, severe accident induced steam generator tube
5 rupture, fire scenarios, and so forth.

6 So since a human is an important -- can be
7 an important contributor to risk, it's also important
8 to insure that the HRA quality is good. So HRA needs
9 to sufficiently represent the anticipated operator
10 performance, and the support of that NUREG standard
11 review plan 19 is noted that modeling of the human
12 performance needs to be appropriate.

13 In addition, the reg. guide for PRA, Reg.
14 Guide 1.200 cites and reflects the ASME standard and
15 industry documents related to what kind of things
16 should be done. So they address what to do, but
17 there's less in those documents on how to do it.

18 So that's what we're trying to address, is
19 to provide better guidance for how to do these things.

20 So our solution then is to develop the HRA
21 good practices as we've talked about, and the goal is
22 to have something that's useful obviously for
23 practitioners, people that are doing HRAs, but also
24 non-experts such as possibly reviewers and NRR that's
25 going to be reviewing submittals for plant changes and

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1 so forth.

2 And incidentally, that's another way HRA
3 is currently being used is for plant changes and the
4 risks associated with plant changes.

5 Okay. So we developed the nature --

6 DR. APOSTOLAKIS: During the subcommittee
7 meeting that I think one member -- I don't remember
8 who -- said that maybe this is too ambitious to have
9 a single document both for reviewers and
10 practitioners, do you remember that? And that perhaps
11 you will need additional guidance for reviewers?

12 MR. FORESTER: That may be the case. You
13 know, I guess that's part of what Reg. Guide 1.200 is
14 trying to do, is a specific guidance for the adequacy
15 of the analysis, and this type of document, you know,
16 assuming you could read this, it would give them some
17 insight about what to look for in reviewing those
18 documents.

19 You may be right. They may need more
20 specific guidance, but this should be a useful guide
21 at some level, I would think.

22 DR. APOSTOLAKIS: Right.

23 MR. FORESTER: So as Erasmia mentioned,
24 we're developing the good practices, and that's what
25 we'll discuss today.

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1 DR. POWERS: John, a couple of months ago,
2 Jay Persensky came down to us and talked about a
3 document they had prepared to describe some screening
4 methodologies for human factors examination of
5 licensee applications. Does that document provide a
6 hint that you need a similar sort of thing for the
7 human reliability analysis of licensee applications,
8 a screening kind of technology, or is that part of it
9 or --

10 MR. FORESTER: I think this would be
11 considered part of that. I mean, I'm not familiar
12 with exactly the work you're describing, but certainly
13 guidance for how to assess human factors issues.

14 DR. POWERS: What was identified then is
15 licensees submit an application that involves some
16 sort of human activity. They would consider the human
17 factors in kind of a rote fashion, whereas what you
18 really wanted was to spend a lot of time on the things
19 where human factors were important and blow off the
20 things where human factors was there, but just not
21 very important in the operation, and so they needed
22 some sort of screening methodology to know how to
23 devote their time.

24 And they came up with this approach that
25 seems like it's reasonably successful in focusing

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1 their attention on the things that are important.

2 Similarly, I would just presume that there
3 are lots of licensee applications that have something
4 to do with human reliability in which human
5 reliability could be quite low and still be quite
6 acceptable; others where the human is very critical in
7 the success of the operation, and so one would
8 obviously want to screen those things, to look at
9 those things, looking at the best practices and
10 whatnot in great detail if human reliability were very
11 important and maybe not so much if it did not matter.

12 I'm just wondering if there isn't another
13 thing on your to do list here or another aspect of the
14 to do list that Jay has pioneered something that we
15 could look at.

16 MS. LOIS: This document is kind of going
17 hand in hand with the one that Jay created. That
18 document helps more to what extent, how much effort
19 the staff should devote to reviewing all of this
20 activity or request.

21 DR. POWERS: Okay. So it really covers
22 what you're doing here.

23 MS. LOIS: But assuming now that some of
24 the requests have been considered important to be
25 reviewed, then if it's a risk informed request, these

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1 documents will help the reviewers.

2 DR. POWERS: Okay. So these things are
3 not independent of each other.

4 MS. LOIS: Absolutely, and we're working
5 on inter --

6 DR. POWERS: I just have to say I thought
7 that that was a singularly good concept that Jay had
8 come up with then, and I would think that the agency
9 would be just cheering like crazy over it because he's
10 finding a way to optimize the resources devoted to
11 these reviews, and that seems like a good idea to me.

12 MR. FORESTER: Okay. This is just a
13 little bit now the bases and the approach for the HRA
14 good practices, of course relying on the SME standard
15 and industry documents that address, again, what are
16 the high level things that need to be done. That, of
17 course, provides some general guidance, and we want to
18 provide more detail for that.

19 What we're doing is based on existing HRA
20 methods and tools that are out there to describe these
21 issues that talk about HRA processes, insights from
22 the literature, reviews of PRA and HRA applications.
23 Both myself and Alan Kolaczowski were an author on
24 this and participated in these applications.

25 So we have experiences from reviewing it,

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1 from reviewing the applications and in conducting the
2 applications also, and of course, we're relying on the
3 reviewers of the document for additional support for
4 the basis of the good practices.

5 So our approach then has been to get
6 consensus from the experts at the NRC in terms of what
7 we're doing. It will be in your internal NRC reviews,
8 ACRS feedback about what's contained in the good
9 practices, and as Erasmia has said, we're going for
10 public comment and input from the international HRA
11 community.

12 In terms of the scope of the good
13 practices, the good practices themselves address
14 reactors at full power, internal events analysis, but
15 in reality these good practices should be useful for
16 anyone doing a PRA whether it's for eternal events or
17 other kinds of modes of operation.

18 The idea is that, you know, these are good
19 practices in any case. What you might need for
20 additional applications, for example, external events
21 or low power and shutdown would be additional
22 information that might need to be done, but I wouldn't
23 expect to find any inconsistencies between what we
24 say. This should generalize I guess is the point I'm
25 trying to make.

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1 We do not endorse a specific method or
2 tool. The good practices should fit with any HRA
3 method that's being used. I will say that in terms of
4 some of the issues, the quantification level, for
5 example, some of the existing methods might have to be
6 adapted somewhat to some special cases, but again,
7 this is meant to be method free.

8 And we have linked it to the ASME
9 standard. In fact, in the document we summarize the
10 high level ASME requirements so that you can see where
11 the good practices fit with respect to the
12 requirements in the standard.

13 And as part of the guidance we also
14 provide some impacts of not performing the good
15 practices correctly. Now, in most cases that
16 addresses things like, well, you'll be in complete or
17 your model will be inaccurate and, therefore, your
18 assessment of risk might not be exactly right.

19 But we talk about that, and we provide
20 additional remarks on how to make sure that the good
21 practices are achieved, and again, we focus on the HRA
22 process as opposed to things like data.

23 When you see the actual HRA good practices
24 document if you haven't, it's organized by logical
25 analysis activities. We begin by talking about the

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1 overall or general good practices and then move to the
2 pre-initiator human events. Pre-initiators are
3 operator actions or maintenance personnel actions
4 associated with calibrating instruments or restoring
5 systems. So these are actions that if done
6 incorrectly could make systems unavailable in case an
7 initiating event occurred. So we want to provide
8 guidance for how to model those pre-initiating or how
9 to identify the pre-initiating events, how to screen
10 them, how to model them, and how to quantify them.

11 Similarly, we address the post initiator.
12 Once an initiating event has occurred, the operators
13 want to strive to restore the plant to a safe
14 condition. We talk about how to identify those events
15 and provide guidance for that, how to model them, how
16 to quantify them, and then address how to add recovery
17 actions to the model.

18 There's also a section in the report that
19 addresses errors of commission and how to document
20 your HRA results.

21 DR. SHACK: But it does this not in the
22 context of particular models; just general discussion.

23 MR. FORESTER: General discussion because
24 we're really focusing on the HRA process here. so
25 there's a lot of activities associated with doing the

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1 PRA and HRA as opposed to just focusing on
2 quantification, for example, which is what most HRA
3 methods focus on doing the quantification process.

4 DR. APOSTOLAKIS: They do develop
5 structure and don't put them down.

6 MR. FORESTER: I'm sorry?

7 DR. APOSTOLAKIS: HRA methods do not
8 necessarily focus on quantification.

9 MR. FORESTER: Not only on quantification,
10 no, but many of them will not provide a lot of
11 guidance for how to identify human failure events or
12 how to put them in the models, and so forth. There
13 are exceptions. You know, there's SHARP-1, the SHARP
14 work that was done by EPRI which provides some of that
15 kind of guidance, but again, that was more of a
16 framework for doing HRA as opposed to a specific
17 quantification process, to just slam more -- the THERP
18 kind of quantifications.

19 DR. APOSTOLAKIS: Does the whole community
20 agree with the terminology "human failure events"?

21 MR. FORESTER: Well, you know, it seems to
22 be being used by most everyone at this point when you
23 see it discussed in the literature and so forth. That
24 seems to be a fairly common terminology.

25 MS. LOIS: ASME has endorsed the human

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1 failure event image.

2 DR. ROSEN: But doesn't this structure
3 lend itself nicely to the discussion of issues raised
4 by organizational environments?

5 DR. APOSTOLAKIS: Sure.

6 DR. SIEBER: It certainly does.

7 DR. APOSTOLAKIS: In fact, I wanted to say
8 the Commission has vetoed research programs whose sole
9 purpose is to study organizational, cultural issues.
10 I don't think the Commission has ever told the staff,
11 "Do not consider organizational factors in the context
12 of human reliability."

13 In other words, if it's an element of a
14 bigger picture, I don't think there is a -- no, but
15 what Erasmia was referring to, there were projects
16 back in the '80s and '90s that had the title, you
17 know, organizational such-and-such-and-such, and the
18 Commission said no.

19 DR. POWERS: I can't imagine me splitting
20 a hair like that with my boss.

21 DR. APOSTOLAKIS: No. You know --

22 DR. POWERS: I think I would ask him if I
23 was splitting the right hair before I went ahead and
24 did it.

25 DR. ROSEN: Well, a pre-initiator --

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1 DR. APOSTOLAKIS: No, there's a difference
2 there.

3 DR. ROSEN: -- on identification. Let's
4 take that one for an example. Organizational issues
5 can dramatically affect the ability of an organization
6 to identify, you know, conditions that are pre-
7 initiated. I mean, it's classic, right?

8 DR. APOSTOLAKIS: Sure, sure.

9 MS. LOIS: So in a way the HRA and PRA
10 include some aspects of organization performance, but
11 not explicitly, and not probably to the extent that it
12 should.

13 Even equipment performance, if you do a
14 true plant specific analysis and in the case of a high
15 unavailability of important systems, one could infer
16 from that that because of corrective action problems,
17 maintenance problems, et cetera. So you have that
18 aspect, the organizational aspect in your PRA without
19 explicitly addressing it.

20 However, you have the capability to do a
21 better job, and that's what we are working on. Now,
22 the title probably was misleading and probably the
23 commission overreacted by saying organizational
24 practice and PRA or HRA.

25 But it isn't that it's totally absent, but

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1 it's not as much as we could have if we had contained
2 the work. That's all.

3 MR. FORESTER: Yeah, there's one area in
4 particular I'll discuss where we do try and get at
5 some of the organizational influences. There's
6 another areas that we actually do not have in the good
7 practices, but based on the subcommittee meeting I
8 think we should include where with respect to pre-
9 initiators and the identification process.

10 There's not a discussion in there about
11 the fact that we do look at how the organization
12 schedules the work, you know. Do one train one day,
13 another train a different day? How do they use their
14 crews? And so there are aspects that we do look at
15 that's not in the document, and I think those should
16 be --

17 DR. ROSEN: With the idea that they're
18 trying to avoid common mode or common cause failure.

19 MR. FORESTER: Exactly. So we do look at
20 it in that sense, but with respect to attitudes and
21 things like that.

22 DR. SIEBER: Standards.

23 MR. FORESTER: We don't really do that.

24 DR. ROSEN: You certainly need to address
25 this. I mean, we're going to write a letter on this

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1 then.

2 DR. APOSTOLAKIS: When the reactor safety
3 study was published, it was all Bayesian, but you
4 won't find the word "Bayes" anywhere because it was
5 controversial.

6 There was a footnote in one of the 11
7 volume, "Sometimes this approach is called Bayesian,
8 but we're not going to use that term." So we use some
9 organizational factors, but call them something else.

10 MR. FORESTER: We just addressed the
11 specifics of it, I think, and that's what we're doing
12 now to some extent, but definitely more needs to be
13 done.

14 Okay. So now from this point on I'll be
15 discussing examples of --

16 DR. APOSTOLAKIS: Is it correct to say
17 it's not a disciplined or multi-disciplinary?

18 MR. FORESTER: I would say multi-
19 disciplinary would be better.

20 DR. ROSEN: Disciplined is what they have.

21 DR. APOSTOLAKIS: Yeah, the HRAs
22 discipline.

23 MR. FORESTER: You're right. It should be
24 multi-disciplinary.

25 DR. APOSTOLAKIS: Okay.

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1 MR. FORESTER: So from this point on I'll
2 be discussing the good practices at a general level
3 and we can get into detail as much as you'd like. We
4 can begin by talking about general good practices. We
5 emphasize the importance of having a multi-
6 disciplinary team participate in conducting the HRA.
7 It should be an integrated effort with the PRA.

8 So the idea is to have operators,
9 trainers, procedure writers, PRA people, systems
10 analysts, and so forth participating very early on in
11 the PRA. You know, it's a bit of an exaggeration, but
12 in the older days I think a lot of what was done was
13 the system analysis guys, engineers would identify
14 what went into the models and then they'd ask the HRA
15 folks to quantify the events.

16 Well, obviously I think the role of the
17 operator should be considered much earlier, and the
18 right people should be involved in doing that, be
19 involved with the guys doing the TH work because what
20 the human can do can affect the timing events. So
21 again, the main point is we want an integrated effort.

22 DR. APOSTOLAKIS: I think this is a good
23 point to discuss in the context of this report that
24 Dana raised earlier that Jay has developed. I'm not
25 sure you guys have thought about it, but if I were to

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1 do -- when I should do this, in the baseline PRA that
2 Jay takes and finds the importance measures and tells
3 me here are the important human actions on which I
4 have to spend more time? But I have already spent the
5 time, or should I first do it crude analysis and then
6 after I have identified the important human failure
7 events, I go and do all of this?

8 It's the issue again that, as you know
9 ATHEANA was criticized for a few years ago, voids.
10 It's the Rolls Royce of human reliability analysis.
11 It costs an arm and a leg. You don't expect anybody
12 to do it. So do we need a phased approach and tighter
13 coupling with that document?

14 I don't know myself, but I mean, if I have
15 to do all of this from the beginning, then you are
16 defeating the intent of the Persensky report.

17 MS. LOIS: I will let Alan Kolaczkowski,
18 who is obviously awake --

19 DR. APOSTOLAKIS: Is he here?

20 MS. LOIS: He's on the phone.

21 DR. APOSTOLAKIS: Oh.

22 MS. LOIS: Alan?

23 MR. KOLACZKOWSKI: Yes, hello. Alan
24 Kolaczkowski.

25 MS. LOIS: Do you want to answer the

1 question?

2 DR. APOSTOLAKIS: Did you hear the
3 question?

4 MR. KOLACZKOWSKI: No, I did hear the
5 question and I understood it.

6 I do recognize that as you say, Dr.
7 Apostolakis --

8 DR. APOSTOLAKIS: Wait, Alan, wait.
9 Can you hear him?

10 THE REPORTER: Not real well.

11 DR. APOSTOLAKIS: No. Can you take the
12 microphone and put it there?

13 You will be recorded. You know, when
14 you're on the phone and being recorded, don't you have
15 to alter the guy?

16 Go ahead. Alan.

17 MR. KOLACZKOWSKI: I heard the question
18 and I understood.

19 (Pause in proceedings.)

20 MR. KOLACZKOWSKI: Should I try again?

21 DR. APOSTOLAKIS: Yes.

22 MR. KOLACZKOWSKI: Is this working better
23 now?

24 DR. APOSTOLAKIS: Yes.

25 MR. KOLACZKOWSKI: Okay. I think the

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1 intent of this first one is not so much to tell people
2 when they have to do it. In fact, that's true of all
3 of the HRA good practices. It's not that every good
4 practice is always applicable. One has to look at
5 what is the scope of work that they're doing and when
6 it makes sense to apply these good practices or not,
7 and that's is stated, testified earlier on in the
8 document.

9 However, I think the intent of this good
10 practice is that not the extent required if you are
11 going to model human failure events in the model,
12 whether it's in the base PRA or whether you're doing
13 some application five years later and you're going to
14 use the PRA for that application and you're going to
15 revisit certain human failure events on the model and
16 adjust them, perhaps modify them, perhaps add others
17 to the model, whatever; what you're saying is it's
18 good practice to not have just the -- again, I'll
19 maybe stress the point a little bit -- not do it the
20 way we did it in the olden days when we just had the
21 system engineer decide what the event ought to be, the
22 time it put in the model and then have the HRA person
23 go and quantify it, but it really should be a
24 collective effort with input from trainers, from
25 operators, et cetera, deciding what the event ought to

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1 be, how it ought to be defined, when it's applicable
2 in the model and when it's not.

3 We think that's a better practice, if you
4 will and is something that ought to be done whenever
5 you're adding or modifying events.

6 DR. APOSTOLAKIS: Okay. I understand
7 that. Let me ask all three of you: would you be
8 amenable to or agreement; would you find it agreeable
9 to add the paragraph in the introduction making the
10 connection of this document, between this document and
11 the other document and maybe say a few words after you
12 think about it a little bit?

13 I'm not asking for a major revision, but
14 I think we cannot issue one report that says, you
15 know, use importance measures to find the important
16 ones and then have another one that says here are the
17 good practices because a reviewer might say, you know,
18 "I don't care what Persensky says. The good practices
19 document tells me to do this. So I'm going to do it
20 everywhere."

21 MS. LOIS: Gareth wants to --

22 DR. APOSTOLAKIS: Gareth wants to confuse
23 the issue. Okay.

24 MR. PARRY: Hopefully to clarify it. This
25 is Gareth Parry.

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1 I think there's a slight misunderstanding
2 here. What Jay Persensky's document is is basically
3 related more to what level of human factors review
4 should I give to, say, a new human action that might
5 be taken to replace an automatic action or something
6 like that. It's really a very specific event.

7 To that extent, the way he uses the PRA
8 results is that the PRA is used to assess the
9 importance of that particular human action, which may,
10 in fact, no even be in the base model because it may
11 be something that's replacing a piece of hardware.

12 I think all of these good practices are
13 really related to how you do the base PRA which helps
14 Jay decide how much resource he has to spend on
15 reviewing that particular action, depending on how
16 risk significant it is.

17 At that point it may be some of that might
18 feed back into a revision of the model.

19 DR. APOSTOLAKIS: Well, I think that a
20 paragraph or two would be helpful making the
21 connection.

22 MR. PARRY: It may be helpful, but --

23 DR. APOSTOLAKIS: You may say that if you
24 want, but as you know very well, people who actually
25 do -- well, people who do PRAs, at least in the old

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1 days, wouldn't go to the full blown Level 2
2 uncertainty analysis immediately. They would start
3 with a point estimate, identify what's important, and
4 then focus on those.

5 So it seems to me that Jay is trying to do
6 something similar, you know.

7 MR. PARRY: He is trying though to --

8 DR. APOSTOLAKIS: He disappointed your
9 reviewer, yeah, yeah, but why should I have to do
10 everything that's in the good practices document even
11 for human actions that will turn out to be
12 insignificant?

13 MR. PARRY: And I don't think you do. I
14 think the way the document is structured is it allows
15 you to screen out certain things.

16 DR. APOSTOLAKIS: There is a screening
17 phase. That's for sure.

18 MR. PARRY: And allows you to go into as
19 much detail as you want.

20 DR. APOSTOLAKIS: Yeah. Anyway, I think
21 a paragraph, summary, introduction would be helpful.
22 Okay. Alan?

23 MR. KOLACZKOWSKI: Yeah.

24 DR. APOSTOLAKIS: Good.

25 MR. FORESTER: Okay. Next we emphasize

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1 the importance of actually going to the plant and
2 participating in the analysis and getting a real sense
3 of what goes on there by doing talk-throughs, walk-
4 downs of, for example, ex-control room actions, if the
5 operators have to leave the control room to carry out
6 certain things. You would definitely want to observe
7 those and look at the timing associated with them.

8 And there's a heavy emphasis on doing
9 simulator exercises. Again, you can't simulate, watch
10 simulator exercises for all of the sequences you're
11 analyzing, but you can learn an awful lot of important
12 information about the way the crews interact, about
13 how they use their procedures, how they implement the
14 procedures, what their attitudes are about various
15 actions they may have to take, whether they feel
16 they're supported, I guess, by management in terms of
17 their ability to decide what to do.

18 So again, you can use simulator exercise
19 to get a lot of information and be relevant to what
20 you include in the model and how you quantify it. So
21 we emphasize the importance of that.

22 And then the final general good practice.
23 They just not that HRA should consider both core
24 damage and larger releases.

25 DR. KRESS: Would you be amenable, using

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1 George's word, to just striking out the third one?
2 Because all it does is place limits on it, and it
3 doesn't add much.

4 MR. FORESTER: It wouldn't bother me. I
5 guess the concern is not everybody always looks at
6 larger or considers human actions related to larger --

7 DR. KRESS: I know, but if you know it's
8 for a PRA and a PRA does that, you're putting limits
9 on it here, which I don't think you want to do because
10 there are other things besides CDF and large early
11 release.

12 MR. FORESTER: That's true. That's a good
13 point.

14 Okay. So now we're moving into some of
15 the good practices associated with the post initiator
16 human events. We begin by, you know, we have this
17 basic book, basic processes, and the first is
18 associated with identifying the pre-initiators. The
19 good practices provide guidance about what to address,
20 what to review. For example, they want to review the
21 test and maintenance procedures, calibration
22 procedures, any kinds of activities that's associated
23 with equipment that's going to be credited in the PRA.
24 So procedures and actions associated with those, with
25 that equipment should be modeled.

1 So the notion is what to review. Anything
2 that is going to render equipment unavailable, then
3 you're going to want to review the procedures and how
4 those things are addressed at the plant.

5 Another point that we emphasize is what to
6 include. We try and talk about what kind of things
7 should be included in the model. Particularly
8 important are single or common mode actions that could
9 affect redundant or multiple diverse equipment. So if
10 an action could affect both trains of the system, for
11 example or, again, they're diverse equipment. You
12 want to make sure those kinds of actions are included
13 in the model.

14 You still might include single actions
15 that affect the single component, but we do provide
16 some guidance, and we'll talk about that later for how
17 to screen some of these types of things out so that
18 you don't have to model and quantify everything that's
19 involved, but there are a few things you do need to
20 make sure you include.

21 And of course, the impact -- we'll address
22 the different impacts of these things -- is that if
23 you don't do the right reviews and you don't include
24 the right things, then you may have incomplete or
25 inaccurate models.

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1 Next.

2 Good practices address how to focus the
3 analysis on the most important contributors. This
4 relates to what Dr. Apostolakis was talking about. We
5 provide criteria that would allow them to say we don't
6 really need to model this action. We don't need to
7 address it.

8 For example, if you have a system that
9 gets a signal to realign when something goes wrong so
10 that if the crews -- the only thing that could happen
11 here is they could just leave it misaligned. If
12 there's an automatic signal that realigns it, then you
13 don't really need to model that. You can be confident
14 that, you know, for most cases you still have the
15 system.

16 Similarly, if there's a compelling signal
17 in the control room that a valve was left in an
18 inappropriate position or a system wasn't restored
19 correctly or something, then again you probably don't
20 need to model that because the probability of it being
21 unavailable is so low that it's not necessary. So
22 there's other criteria that we provide, again, to help
23 them screen out these different kinds of initiators.

24 Again, we emphasize not screening out
25 things that will affect multiple equipment, and then

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1 we also make a note about that if this is a -- for
2 example, a licensee may have submitted a change, a
3 plant change, and the PRA is going to examine that.
4 Well, if in that analysis certain pre-initiators were
5 excluded, then with the plant change though you
6 probably need to revisit those to make sure that they
7 are not relevant now or that the change didn't affect
8 some assumptions you made earlier on.

9 The good practice, that it address how and
10 where to include the pre-initiated events in the
11 model. So you know, within PRA you're building event
12 trees and fault trees. It's fairly easy. You can be
13 logical in terms of -- the logic can be correct in
14 terms of where you place things, but in terms of
15 traceability, potentially understanding dependencies
16 between those actions and so forth, there's guidance
17 about trying to tie the different actions to the
18 component or the system or the function or whatever
19 that's being addressed to make sure they're in the
20 right place and you'll have good traceability.

21 Another related good practice is when it's
22 okay to combine multiple individual acts in a single
23 event. So restoring the system, for example, might
24 involve multiple actions. In some cases, you might be
25 able to treat that as a single human failure event.

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1 In other cases it might be a better idea to break it
2 apart to some extent and provide guidance for when it
3 might be appropriate to have the subtasks or sub-
4 events essentially.

5 You know, if the acts and the effects are
6 going to be the same, if all of the performance
7 shaping factors are going to be the same, and there's
8 no potential dependencies between some aspects of the
9 overall task, then you can probably treat them as a
10 single human failure event. So there's guidance
11 there, again, to help in the modeling process.

12 There's essentially eight good practices
13 that address quantifying the pre-initiators. These
14 are some of the main points. Folks are learning how
15 to do detailed analysis of the events that were not
16 eliminated during the screening process. We focus on,
17 again, emphasizing the importance of revisiting that
18 screening analysis when you're looking at plant
19 changes and so forth or new submittals that change the
20 base PRA.

21 It talks about what performance shaping
22 factors could be important for pre-initiators to make
23 sure they address the right things. You know, the
24 primary method that is used for pre-initiators is a
25 set third (phonetic) technology, and there's guidance

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1 in there, and this just reemphasizes, you know, the
2 important ones such as having written check-offs and
3 how often the plant changes and whether there are
4 signals in the control room and so forth.

5 And then there's some guidance given for
6 deciding whether the probabilities are reasonable.
7 You know, when you look at this particular probability
8 for an action and another reaction, does it make
9 sense? Is one of them fairly complex? Does it have
10 a probability that -- the other one may be very simple
11 -- you know, does one have a higher probability of
12 failure than the other?

13 So this is guidance for how to check and
14 make sure that the probabilities are reasonable.

15 And now we're moving into the post
16 initiator human failure event and good practices.
17 Again, we start out by giving guidance about how to
18 identify post initiators, what to review. You know,
19 you've got to look at the emergency operating
20 procedures because now we're looking at actions
21 associated with responding to initiating event.

22 Abnormal operating procedures, enunciator
23 and alarm procedures. So if it's possible that you
24 might get an alarm and there's a particular procedure
25 or action indicated by that alarm; if the alarm is

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1 wrong, could that lead to possibly taking an
2 inappropriate action?

3 So, again, it emphasizes what kinds of
4 procedures should be reviewed and how to consider
5 them.

6 Examining training material to understand
7 how the operators are trained to respond to particular
8 events, and of course, doing simulator runs so that
9 you review the procedures. You review what the
10 control room does. You look at simulator exercises
11 and try and get some idea about plant philosophy with
12 respect to how operators should respond in that
13 particular scenario.

14 And then we provide it again trying to
15 give them some general types of actions that they
16 should expect to be included. Obviously if there's an
17 automatic start of the system expected, then there are
18 going to be modeling failure of that other start, and
19 then the model and the human action to manually
20 initiate the system.

21 It addresses non including heroic actions
22 and emphasizes that all of the actions should be
23 procedure based. So no non-procedure based actions.
24 So, again, the idea is to give them guidance about
25 what to include or not include.

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1 I think in the handouts you may have we
2 noticed right at the last minute that a couple of
3 pages were out of order. We're now going to page
4 number 18. I think 20 got in the wrong place.

5 Okay. So we're on Slide 18, which is
6 modeling post initiators.

7 Again, we're talking about how to include
8 these actions in the model and what level. Is it a
9 functional level? Should it be modeled relative to
10 the system, the training of the component?

11 The basic event needs to be linked to the
12 equipment that's going to be affected, and is the poor
13 performance related to the train and what's going to
14 be effective.

15 It also points out that the modeling
16 should be based on plant and accident sequence
17 specific characteristics. So where you include an
18 action in an event tree, for example, it depends on
19 the sequence timing. When is the action going to be
20 relevant? What are the cues going to be for the
21 actions? How are the procedures and the training
22 represented in terms of when that action might take
23 place?

24 Where the action has to take place could
25 be relevant where it's model, and of course, insights

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1 from the simulation and walk-throughs and so forth.
2 So again, it helps them understand the things they
3 need to consider in order to be able to include these
4 things in the models.

5 And the next slide here addresses how we
6 quantify post initiators, the guidance we'd give them.
7 The good practices address the importance of modeling
8 both cognitive and execution failures. So if the
9 control room has to diagnose the need to take the
10 action, obviously that should be included. It could
11 be a particular failure probability associated with
12 that.

13 But you also have to look at the execution
14 failures. This is a very simple task where you're
15 simply turning a switch in the control room. I mean,
16 that execution failure may be fairly low probability,
17 but in other situations it could be fairly
18 significant. If there's ex control room actions
19 involved, possibly throttling various kinds of
20 injection systems might be a little trickier than
21 others. So, again, it's just emphasizing the
22 importance of the need to consider both cognitive and
23 execution.

24 DR. ROSEN: Failure to diagnose in the
25 control room is a crew activity, right?

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1 MR. FORESTER: Yes.

2 DR. ROSEN: So you'd have to have the
3 probability of the whole crew, not just --

4 MR. FORESTER: That's correct.

5 DR. ROSEN: -- not just one individual.

6 MR. FORESTER: That's absolutely correct.

7 We talked about I shouldn't say the crew, in fact,
8 rather than the individual because --

9 DR. APOSTOLAKIS: In fact, I wanted to
10 make that comment. It seems to me that when it comes
11 to evaluating crew performance, we are not really up
12 to date, are we?

13 We tend to treat the group as one entity,
14 and in many instances this is not quite right. So --

15 MR. FORESTER: That's true, and we
16 actually do try and address it. That's one of the
17 things we get from looking at simulator exercises.
18 You see how the shift supervisor, for example,
19 interacts with his crew. Are some of the crew members
20 allowed to do things independently? Are there some
21 actions that they have the privilege essentially to
22 take on their own and then report to the shift
23 supervisor later?

24 Or is it everything has to go through the
25 shift supervisor? How do they handle --

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1 DR. ROSEN: We're just talking about
2 diagnosis at the moment. At least I was just trying
3 to say what's happening here. That's the question,
4 and that's a crew activity, and the crews are
5 different, depending upon the structure of the control
6 room staffing.

7 MR. FORESTER: That's correct.

8 DR. ROSEN: I mean, I can think of one
9 plant where there are two units controlled from one
10 control room. So there are two unit supervisors, two
11 crews, two unit supervisors and one shift manager who
12 kind of sits in the middle, and that's a complex crew.

13 And when you're thinking about trying to
14 find an error or diagnosis, you know, you have to
15 think about a complex crew environment, but that's the
16 most complex one I've seen. But there are simple ones
17 that you'd have to think about, too, and the
18 probability of failing to diagnose might be different
19 for different crew compositions and structures.

20 I'm just saying that this is not just one
21 number.

22 MR. FORESTER: Well, I think you can get
23 to one number if you've considered those
24 internationals.

25 DR. ROSEN: No, I understand, but --

1 MR. FORESTER: No, I agree with you that,
2 you know, ultimately it's the plant supervisor
3 responsibility, but if there's a particular scenario
4 or context that's involved that has confused one crew
5 member, well, that influence could then carry over to
6 the shift supervisor.

7 So you have to sort of evaluate how as a
8 team they might respond to that situation.

9 DR. ROSEN: Right, and I'm thinking more
10 broadly in terms of a capability that you're
11 suggesting in this good practice to build into HRA.
12 That capability needs to be applicable to very complex
13 situations like we're considering for what has been
14 proposed for certain advanced plants, many modules,
15 one control room, many modules, very few operators.

16 MR. FORESTER: And I agree with that, and
17 that's an area that we haven't done enough work in.

18 MS. LOIS: The current state of the art
19 cannot handle it well, with the exception of ATHEANA
20 that tries to take into consideration all different
21 aspects, and that's why we have the Holden simulator
22 experiments.

23 And Dr. Apostolakis has recommended to
24 review what other second generation HRA methods do,
25 but you have recommended that crew activity to look at

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1 for the HRA purposes.

2 DR. ROSEN: Well, I'm just trying to
3 explore the dimensions of some difficulties, the real
4 world difficulties in dealing with crews or crew
5 structures and crew challenges. Those, plus the ones
6 I've mentioned before about not having the crew that
7 you trained with in the simulator really on shift with
8 you when the event occurs because somebody is off
9 relieving something else.

10 So you know, there are some real issues to
11 be dealt with in how one goes about HRA under the
12 complex circumstances.

13 DR. APOSTOLAKIS: John when you talked
14 about the slide, you said it's important for the
15 analyst to consider both cognitive and execution
16 failures.

17 MR. FORESTER: Yes.

18 DR. APOSTOLAKIS: You didn't use the word
19 "model" that you have on the slide. I think that is
20 a dangerous word to use there. "Consider" I think is
21 much more appropriate.

22 Surely you're not asking them to start
23 modeling cognitive processes and make Dr. Kress upset,
24 and it's an impossible task to begin with. So what
25 you mean is consider the possibility of misdiagnosis

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1 and maybe whatever else may affect performance, but
2 you don't mean modeling.

3 MR. FORESTER: No, I think the model
4 referred to is you want to have a cognitive element
5 and an execution element that you consider. You're
6 right.

7 I mean, some how we're trying to model the
8 group cognition, but obviously we don't have --

9 DR. APOSTOLAKIS: Is the IDEA model from
10 Maryland focusing a lot on --

11 MS. LOIS: We are just looking into that.

12 DR. APOSTOLAKIS: -- on the cognitive
13 processes and so on?

14 MR. FORESTER: Yes.

15 DR. APOSTOLAKIS: You don't meant that.

16 MR. FORESTER: No.

17 MS. LOIS: But even that is very simple
18 minded.

19 DR. APOSTOLAKIS: Yeah.

20 MS. LOIS: It seems three people, and it's
21 -- yeah.

22 DR. APOSTOLAKIS: Still, I mean, you're
23 getting into the realm of psychology. I'm sorry,
24 John.

25 MR. FORESTER: No. It's hard to use right

1 now.

2 DR. APOSTOLAKIS: You're an applied
3 psychologist, are you not?

4 MR. FORESTER: I'm aware of the
5 limitations there. So that's good work; it's
6 important work, but when it will be useful to HRA is
7 another question.

8 DR. APOSTOLAKIS: Okay.

9 DR. ROSEN: You know, the problem you face
10 is a little bit like the one we used to face and we
11 still face like, say, in thermal hydraulics where we
12 know this is a three dimensional world, and in three
13 dimensions things behave differently than they do in
14 one dimension, but we can't really do much more than
15 one dimensional analysis or two dimensional analysis.

16 So you know, you're always attempting to
17 approximate the real world. So the real world is
18 crews operating under stress and short time frames
19 with some of the other features that I mentioned
20 before, you know, complex command and control
21 arrangements, et cetera.

22 And you're really trying to model that to
23 get the right answer because you may get a different
24 answer if you take a one dimensional model of human
25 performance. It may look very easy with a one

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1 dimensional model. Sure, he gets the signal and he
2 follows his procedure and shuts it off.

3 Well, yeah, but that's not exactly how it
4 turns out in the real world.

5 MR. FORESTER: That's correct. That's why
6 I think ATHEANA has emphasize the air forcing context.
7 And we talk about the importance of context more
8 generally in the good practices. Just the things
9 you're saying needs to be considered. These are the
10 most likely things that influence performance. You
11 need to sort of look at it in the real world sense
12 rather than some special processes inside the brain.
13 I mean, it would be good if we could do that if we had
14 the data.

15 DR. ROSEN: But what I'm saying is we're
16 just calibrating each other here, but that's not how
17 it really works, and that if we're really trying to
18 model how it really works three dimensionally, you
19 know, how the fluid really flows, it's more --

20 DR. APOSTOLAKIS: One way of handling
21 those approximations, Steve, would be to actually see,
22 collect the evidence, what happens in that real world
23 and ask yourself, "Am I missing in my model something
24 important that appears to be driving operating
25 experience?"

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1 Now, have we ever done that? I know that
2 there have been collections of events and so on and
3 analysis, but this last step might, in fact, be a
4 good, convincing argument that certain performance
5 factors that we don't consider now should be
6 considered.

7 I remember there was a NUREG or two way
8 back, you know, human error events, failure events
9 during shutdown. It was a very nice listing of
10 things, analysis and so on. But the next step, which
11 is to look at the whole report with however many
12 events it has analyzed and then synthesize and say,
13 "Hey, we see here like prioritizing maintenance, for
14 example, appears in every other event. Is that in
15 anybody's model?"

16 And say, well, this is strong, because
17 then you will have to go to the two dimensional world
18 that Steve mentions, but that is you have a basis.
19 Okay?

20 MS. LOIS: That's correct. We hope we'll
21 obtain through HERA. That's why we're developing the
22 database.

23 DR. APOSTOLAKIS: Okay, okay.

24 MS. LOIS: And HERA has a structure that
25 is amenable to HRA analysis, and the analysts will be

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1 able to do the searches for various types of --

2 DR. APOSTOLAKIS: You know every well
3 though that HERA was betrayed many times.

4 And the other thing, Steve, after 40 years
5 of extensive research, thermal hydraulics, I don't
6 know whether they're modeling the three dimensional
7 world well or --

8 DR. ROSEN: At least they know there's a
9 three dimensional world there.

10 DR. APOSTOLAKIS: Unfortunately Professor
11 Wallis is not here.

12 DR. ROSEN: But they know there's a three
13 dimensional world, and what's more, they're allowed to
14 discuss it.

15 DR. APOSTOLAKIS: Well, they do miraculous
16 things there. They even take vectors and convert them
17 to scale-ups.

18 DR. POWERS: George, one of the issues
19 that has come before this committee that continues to
20 arise in my mind, arose in the BWR power up-rates for
21 a particular event, was analyzed both before the power
22 up-rate and after the power up-rate, and the human
23 error probability was assigned to it, and of course it
24 was a little bit higher after the power up-rate
25 because the time available had shortened somewhat.

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1 Well, in some cases it was a substantial
2 shortening because there was a relatively short period
3 of time available.

4 But the thing that harps in my mind is
5 that even for those people where there was a short
6 time available, the licensee assured us they tested
7 this thing routinely. They had tested it 50 times
8 with every crew that they had ever had, and no one had
9 ever failed to perform the function in 30 seconds when
10 I think he had seven or four minutes to do it, some
11 substantial time. It had always been done very
12 reliably.

13 And the question that comes into my mind
14 on assigning the human probability gets back to the
15 "do they make sense" question. You know, when faced
16 with that, how do I answer that question? Does it
17 make sense?

18 The human error probability was like all
19 of them at .01 or something like that. I mean,
20 they're all kind of the same, and yet the database
21 here is not inconsistent with .01. I mean, you could
22 look at 50 times and no errors. It's still consistent
23 with .01.

24 Does that make sense? Do we know whether
25 that makes sense or not?

1 MR. FORESTER: Does the value make sense?

2 DR. POWERS: Yeah.

3 MR. FORESTER: Well, you know, to
4 determine whether it makes sense, again, I think you
5 have to evaluate what's involved in the decision
6 process and what the event would be, and once you do
7 that and you have other events that are examined that
8 have different characteristics, you can compare the
9 probabilities amongst those to see if at least
10 relatively speaking it makes sense, I guess.

11 DR. POWERS: Well, here's what I'm really
12 asking you. Here these guys train on this thing.
13 They do their thing, and I'm sure they use THERP for
14 the analysis on this. You clearly gave credit for the
15 training in assessing the probabilities. I don't know
16 the details of what they did, but you would ordinarily
17 do that. You'd take something.

18 They come up with a number, and of course,
19 to them they were being enormously conservative when
20 they evaluated because 50 out of 50 times the guy had
21 done the job, and he had done it in a time that was
22 minimal compared to the time that was available. So
23 clearly the licensee was coming in and saying, "Well,
24 this number I put in here is very conservative. So
25 you guys can take confidence."

1 And the question that keeps running into
2 my mind is: is it really that conservative?

3 DR. ROSEN: Well, I think, Dana, you had
4 your finger on it. The question they were answering
5 was the case in point, was the throwing of a key lock
6 switch in the control room, and when an operator knows
7 he has to throw the key lock switch, 50 out of 50 of
8 them were able to do it. The question wasn't whether
9 he could get from his seat to that key lock switch in
10 throw it. Everybody agreed that was possible.

11 It was a question whether he would know he
12 had to do it, was the part that no one could assess.

13 DR. APOSTOLAKIS: Which brings up the
14 issue of again how credible are these simulation
15 exercises. In a real time environment --

16 DR. POWERS: I mean those are the
17 questions we ask around it, and I was just asking John
18 to contribute to our debate just because it just won't
19 go away in my thinking.

20 DR. APOSTOLAKIS: It will never go away.

21 DR. POWERS: Oh.

22 DR. APOSTOLAKIS: I don't think so.

23 DR. ROSEN: It's because they didn't
24 address the big --

25 DR. POWERS: You mean 100 years from now

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1 when I'm on my death bed I'll be saying, "Hell, I
2 wonder if that guy could really do that."

3 DR. APOSTOLAKIS: My words, 100 years from
4 now.

5 DR. ROSEN: Dana, you have to ask the
6 right question for them to get closer to the right
7 answer, and the right question is not whether he could
8 turn the switch. It's whether he would know that he
9 needed to turn the switch.

10 DR. APOSTOLAKIS: Yeah, that's the
11 difficulty with the simulations.

12 DR. ROSEN: Right. They never asked that
13 question or they never addressed the question of
14 whether he would know that he needed to turn --

15 DR. POWERS: Well, I think they were
16 implicitly -- I admit with you in our discussion of it
17 they didn't understand what we were asking, but I
18 think implicitly they did. I mean, they're just on
19 the hot seat here and they're trying to get a license
20 extension.

21 DR. APOSTOLAKIS: Yeah.

22 DR. POWERS: And things like that.

23 DR. APOSTOLAKIS: But I think we were
24 supposed to finish this by 4:45.

25 DR. POWERS: This is interesting stuff,

1 George.

2 MR. FORESTER: It certainly is.

3 DR. POWERS: This is what the staff should
4 be doing here even if it doesn't have immediate
5 applications.

6 MR. FORESTER: Okay. This just continues
7 then with the good practices we're going to address.

8 DR. APOSTOLAKIS: So you're going now to
9 Slide 23 or what?

10 MS. LOIS: Twenty.

11 DR. APOSTOLAKIS: See the big difference
12 if you put the "the" there? "Errors of the
13 Commission."

14 (Laughter.)

15 DR. APOSTOLAKIS: You'll be in real
16 trouble.

17 DR. POWERS: Yeah, but there's not enough
18 room on the slide, George.

19 (Laughter.)

20 DR. APOSTOLAKIS: I swear you would be in
21 trouble. So what if their errors were to incur a EOC
22 surface, right?

23 Okay, John. You only have four minutes.

24 MR. FORESTER: Okay. Quickly, we do
25 include some guidance about treatment of errors and

1 commission. I imagine as everyone knows,
2 traditionally PRA and HRA has not included errors of
3 commission in the model. The thought was that they
4 would tend to be low probability, and there are so
5 many possibilities it would be a very difficult
6 search.

7 We think some of the newer techniques has
8 provided ways to reduce the search to make it more
9 useful at least to go ahead with the search. We
10 encourage that EOC searches be done, particularly in
11 submittals if there are plant changes for
12 applications; encourage to investigate if those
13 changes could create situations that now might confuse
14 the operators so that if now the way the systems are
15 behaving it would be different than the way they were
16 before. If some of the operators change and so forth,
17 they might get set up, for example, to take an
18 appropriate action.

19 So the main idea here is, again, to not
20 require errors of commission, but encourage that they
21 look for them and some guidance for when they might be
22 important, when there's a chance you might find them
23 and they would turn out to be important.

24 There's a section on HRA documentation,
25 the various aspects involved with doing that. I can

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1 go through those if you'd like.

2 DR. SIEBER: We can read it. No.

3 MR. FORESTER: No, okay.

4 DR. APOSTOLAKIS: This is a very
5 prescriptive document though, isn't it? I mean
6 disciplines involved. I don't remember exactly how
7 you put it, but don't make it sound like you have to
8 have -- I mean, the discipline is okay, but it's
9 conceivable that one person, let's say, an engineer
10 who has been doing this for 20 years, that he could
11 represent another discipline as well, right?

12 You don't necessarily mean you have to
13 have an engineer. You have to have an operator. You
14 have to have a psychologist.

15 MR. FORESTER: No.

16 DR. APOSTOLAKIS: That would be awfully
17 prescriptive.

18 MR. FORESTER: No, I don't think that's
19 the case.

20 DR. POWERS: But you do indicate that you
21 have to have a chemist.

22 MR. FORESTER: I don't think we really
23 name. We might have some names in there, but we all
24 have chemists.

25 DR. POWERS: He doesn't want one of those.

1 MR. FORESTER: And another point I think
2 is that we acknowledge that depending on what your
3 application is, not all of these things may be
4 necessary.

5 DR. APOSTOLAKIS: So I really think you
6 ought to separate or to say very clearly somewhere
7 that a renewer of an HRA shouldn't really follow these
8 things. A reviewer should be more performance based.
9 I mean, you don't want the reviewer to say, "Ah, did
10 you actually walk into this place, or did you actually
11 make a right turn?"

12 I mean, come on. The analysts should do
13 things like that. So the more I think about it the
14 more I think you really ought to make a distinction
15 between a review document and the guidance for
16 analysis document because a lot of the things you said
17 make perfect sense for the analyst, but I'm not sure
18 about the reviewer.

19 MR. FORESTER: But you just want to
20 examine -- I don't disagree with you entire, but I
21 guess one example is if the renewer is looking at the
22 document and he notices that there's no mention that
23 they actually walked down the action, that they might
24 say we estimated how long it was going to take.

25 Well, if time is very important and

1 they're relying on someone's judgment of how long
2 something might take, then that might be a reason for
3 concern, not necessarily depending on how the rest of
4 the analysis reads, but --

5 DR. APOSTOLAKIS: I agree. I agree, and
6 I may even argue that this is a performance based
7 comment. You're giving me an estimate. I have the
8 right to ask you how you got it, right? So that's
9 performance based.

10 MR. FORESTER: That's true.

11 DR. APOSTOLAKIS: But to say that, boy,
12 you have to have walked down, well, gee, you know.

13 MR. FORESTER: Yeah, that's true. It does
14 get kind of tricky because, again, depending on what
15 the application is and the nature of what was being
16 done, not all of these things would be absolutely
17 necessary.

18 DR. APOSTOLAKIS: I think you should make
19 the distinction clear either in this document or maybe
20 say that somewhere else you're going to.

21 MS. LOIS: But the walk-down, et cetera,
22 is part of the ASME standard, is a part of the PRA
23 standard.

24 DR. APOSTOLAKIS: Well, this particular
25 thing maybe you're right, but in general, I think your

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1 focus has been the analyst. Maybe all you have to do
2 is go back and think again and say now for the
3 reviewer, do I want to say this. You know, I'm not
4 saying that you should start another project, but just
5 look at it again.

6 MS. LOIS: Another step that probably will
7 be next step is to develop a review guidance. This is
8 not a review guidance.

9 DR. APOSTOLAKIS: And maybe you can say
10 that up front.

11 MS. LOIS: Yeah.

12 DR. APOSTOLAKIS: A lot of these things
13 can be resolved easily by writing, expanding the
14 introduction, and explaining to people what your
15 intent was.

16 MS. LOIS: Okay.

17 DR. APOSTOLAKIS: Okay.

18 MR. FORESTER: I guess this is just a
19 slide on the usefulness. We still think it could be
20 useful for reviewers, again, just general knowledge
21 about what's appropriate.

22 DR. APOSTOLAKIS: Very good. Any comments
23 from the members?

24 DR. LEITCH: I had a question about the
25 last bullet on 15 and 19. Basically after we go

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1 through all of this, we say does it make sense. I
2 mean, if we knew it made sense at the beginning, why
3 would we go through all of this?

4 I mean, are we just developing a technical
5 rationale for an intuitive feeling anyway? And then
6 if it doesn't turn out right, well, there's enough
7 flexibility in this thing we can go back and say,
8 "Well, we should have given more weight to this or
9 more weight to that"?

10 And the bottom line is we come out with
11 what we intuitively believe from the get-go?

12 MS. LOIS: Can I answer that?

13 These criteria came more from our
14 experience with IPU use. We had seen a lot of IPUs
15 provide the very detailed documentation of how they
16 came up with an estimate.

17 However, if you look at the estimates from
18 the perspective of do they make sense, then did not.
19 For example, we show one particular IP where the
20 operator failure to scram, which we suggest at the
21 bottom it was ten to the minus three, and then failure
22 to feed or bleed was ten to the minus five, and that
23 is the aspects that it makes sense that we're looking
24 for here.

25 You know, failure to feed or bleed is a

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1 very complicated activity. The operators are dreaming
2 how to scramble the reactor. I don't think they are
3 dreaming how to feed or bleed, et cetera.

4 So it's more the logical relationship or
5 this.

6 On the issue that the good practices are
7 addressing is the fact that a lot of HRA experts, we
8 sort of didn't agree, did not have a good
9 understanding of how to do HRA, and they may apply a
10 particular method, quantification method, for example,
11 THERP, to an extreme degree so that they could come up
12 with estimates that are not logical.

13 So it's a bad aspect of it. You're
14 supposed to rationalize your numbers afterwards.

15 MR. PARRY: Could I add a comment here?
16 This is Gareth Parry again.

17 I think part of the intent of this is to,
18 in fact, make sure that the analyst revisits all his
19 estimates in one table and make sure that they're in
20 relative agreement.

21 I mean, these analyses may be done over a
22 protracted period of time. There's an element of
23 subjectivity that goes into all of them, and I think
24 all this is doing is saying that it may be necessary
25 to recalibrate yourself and one day you might have not

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1 felt very good. So you were being particularly
2 pessimistic about something.

3 It's a sanity check and making sure that
4 the event that has a more challenging set of
5 conditions associated with it, in fact, is a lower
6 error probability than one that has a more
7 straightforward set of characteristics.

8 So I think really it's a sanity check in
9 making sure that on a relative basis things make
10 sense.

11 DR. LEITCH: Yeah, I hear what you're
12 saying. I guess you're talking to a skeptic
13 admittedly, and you know, I don't have a whole lot of
14 confidence in this particular scientific discipline
15 because I think the uncertainties are so great that
16 they swamp what you're trying to do here.

17 MR. PARRY: I would agree that the
18 uncertainties are large, but I think you can take
19 those into account by the way that you use the
20 results, and by the way that you use them in the
21 decision making process.

22 I think part of the discipline is to
23 recognize that your uncertainties are, indeed, large
24 and to still be able to make useful conclusions.

25 DR. APOSTOLAKIS: Anything else?

1 DR. LEITCH: You know, this is largely an
2 empirical science, and yet there's very little mention
3 of data or validation of these methods, and I'm just
4 wondering how do you.

5 DR. APOSTOLAKIS: Well, you're raising a
6 much bigger issue now, but they have problems to
7 collect data and so on. Here they're just saying,
8 "Look. If you want to do a decent HRA, there are many
9 models out there, but certain good practices have been
10 emerging over the years, and here they are."

11 We are not trying to quantify anything
12 here, but that question is more relevant to the other
13 stuff they're doing, which we will discuss some other
14 time.

15 DR. LEITCH: Yeah, I feel it's a very good
16 document on what those good practices -- what things,
17 one, ought to consider. My question is concerning our
18 ability to quantify those things.

19 DR. APOSTOLAKIS: A lot of people have
20 those doubts.

21 DR. LEITCH: I certainly have no
22 objection, and I think it's a good piece of work, and
23 if the question is should we issue this for public
24 comment, I think that's great.

25 DR. APOSTOLAKIS: Yeah, this does not

1 address quantification anyway.

2 DR. POWERS: I guess the way I have looked
3 at it is I'm not sure that I would stake my life on
4 the .01, which is the number that always comes out on
5 these things versus .05 or ten to the minus fifth.
6 But I'm pretty sure that when they come in and say,
7 "We judge this action to be more complex and as a
8 result the likelihood for human error to be higher
9 than this other action," then I think they're on
10 pretty good ground there.

11 DR. APOSTOLAKIS: Right.

12 MR. FORESTER: I think so.

13 DR. POWERS: And so it's like free energy.
14 You don't know exactly where the zero is, but you sure
15 know what the deltas are to a great precision.

16 And I particularly like Gareth's comment
17 that, recognizing you have broad uncertainties is, of
18 course an essential element to the interpretation of
19 these, and I point out that in severe accidents we
20 make enormous strides even though we work with decades
21 and decades of uncertainty all the time.

22 DR. APOSTOLAKIS: The only thing is that,
23 again, we are off the subject now, but the effort to
24 quantify has led to all of this qualitative work.
25 Erasmia referred to the second generation models.

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1 Well, there was a first generation model which
2 basically said they were really numbers oriented, and
3 the most sophisticated one would say if the operator
4 has so many minutes, he has the probability he will
5 make a mistake.

6 And then people realized that this was not
7 good enough, and they started bringing into the
8 process models that were developed elsewhere by well
9 known people and so on.

10 So the numbers drove the qualitative
11 models, and I think we have gained a lot of good
12 insights. Now, the numbers are still up in the air.

13 CHAIRMAN BONACA: But I think this effort
14 to quantify, you're absolutely right. For example --

15 DR. APOSTOLAKIS: It's a discipline.

16 CHAIRMAN BONACA: -- help tremendously in
17 the control room designs. I mean, there were a lot of
18 upgrades that took place on a plant specific basis in
19 the '80s, early '90s, that were really tied to an
20 attempt to understand further action, particularly for
21 older plants, some of the critical sequences. You
22 know, you do go through recirculation. You have to do
23 certain things. Some of the more modern plants were
24 set up to have high confidence that the operator would
25 do that. Some of the older plants did not even have

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1 the same level of confidence.

2 In fact, you could look at a simulator and
3 see the response of that and understand that you had
4 critical issues there. If you had to quantify still
5 today, you would have significant uncertainties. But
6 there is much higher confidence that they will do it
7 correctly because you can see it on the simulator how
8 the respondents are.

9 So I believe this effort to quantify has
10 been very helpful.

11 DR. APOSTOLAKIS: And not only that, but
12 look at the efforts of the design of the new
13 generation plants. One of the requirements is, you
14 know, don't ask the operators to do anything for the
15 first 24 hours or the first 70 hours. All of that
16 came from this kind of analysis and worry that time is
17 critical, along with other things.

18 The designers cannot make sure that the
19 operators feel good, but they can do something about
20 the available time. So the EPRI -- what was it
21 called? -- utility requirements document explicitly
22 said that, that the next generation, I think, for 24
23 hours they have to do nothing, and then for another
24 period of time something else.

25 So there are some practical results that

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1 have come out of this, but the numbers, you're right.

2 CHAIRMAN BONACA: But if you take PWRs, 20
3 years ago the likelihood that operators would go into
4 bleed or feed, although the direction was there, it
5 was very low. In fact, they would into the procedure
6 and see what they were planning to do. I mean, there
7 were informal points of self-training almost that are
8 given there about doing things.

9 And today because of the focus on this
10 actions required to do that and the training, there is
11 much higher confidence there because you can see the
12 crews now when they're supposed to go to bleed and
13 feed, they do so. They do that, and they do it within
14 the allotted time, and you can see it on the simulator
15 how they respond to that.

16 So this has all come from this focus on
17 operator action.

18 DR. APOSTOLAKIS: Okay. Any other
19 comments? Questions from the members? Would the
20 staff like to make a comment?

21 (No response.)

22 DR. APOSTOLAKIS: No? Well, Erasmia and
23 John, thank you very much.

24 MR. FORESTER: Thank you.

25 MS. LOIS: Thank you.

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1 DR. APOSTOLAKIS: We appreciate your
2 coming again, and I guess you will hear from us some
3 time in the next two weeks.

4 MR. FORESTER: Okay. Thank you.

5 MS. LOIS: Thank you very much.

6 MR. FORESTER: Thank you very much.

7 DR. APOSTOLAKIS: Back to you, Mr.
8 Chairman.

9 CHAIRMAN BONACA: Okay. With that we will
10 go off the record now, and we'll take a break until
11 5:15 and get back here and talk about letters. I
12 actually want to have John coming in because he has
13 some messages to give us about the discussion on
14 Saturday morning I would like him to hear.

15 (Whereupon, at 4:57 p.m., the Advisory
16 Committee meeting was concluded.)

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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

512th Committee Meeting

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.



Rebecca Silberman
Official Reporter
Neal R. Gross & Co., Inc.

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MOX Fuel Lead Assembly Program

Advisory Committee on Reactor Safeguards
NRC Offices - White Flint, MD

Steve Nesbit
MOX Fuel Project Manager, Duke Power
May 6, 2004



Outline of Presentation

- ⇒ Introduction
- MOX fuel - general
 - Safety evaluation
 - Environmental evaluation
 - Summary



Plutonium Disposition Program

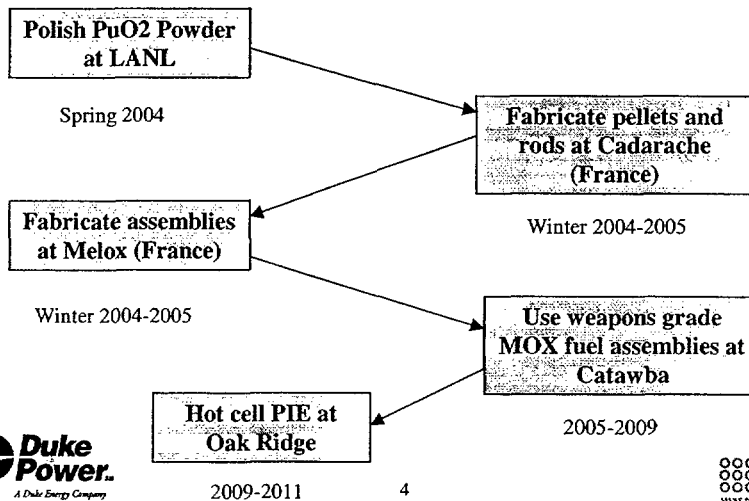
- 1994 National Academy of Sciences Report – surplus weapons material poses a “clear and present danger”
- September 2000 – U.S.-Russian agreement that each country will dispose of 34 tonnes of its surplus weapons grade plutonium
- Approach – fabrication into mixed oxide (MOX) fuel and use in commercial nuclear reactors
- The lead assembly program is an essential element of the plutonium disposition program
 - Required to qualify MOX fuel for use in United States reactors



3



Lead Assembly Program



4



Reactor Use of Lead Assemblies

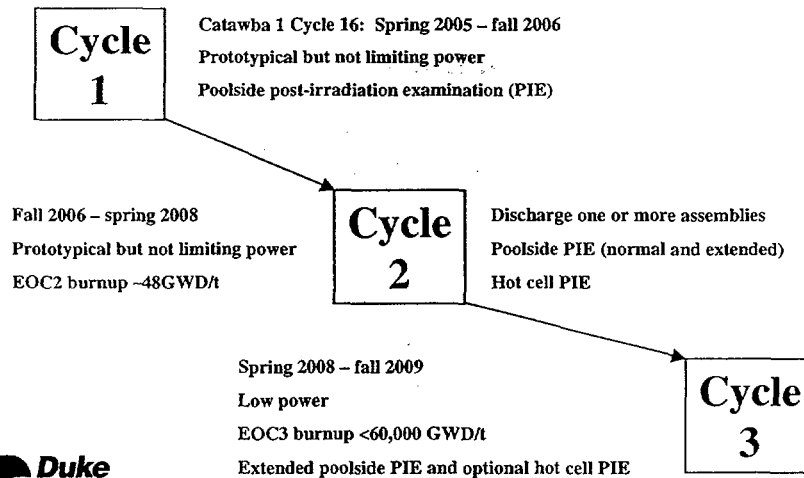
- **Catawba Nuclear Station**
 - York County, South Carolina
 - Unit 1 began operation in 1984
 - 3411 MW_{th} pressurized water reactors operated by Duke Power
 - Westinghouse four loop design
 - 193 fuel assemblies in each core
 - Ice condenser containments
- **Catawba and McGuire (the four “mission reactors”)** have a common core and reactor coolant system design



5



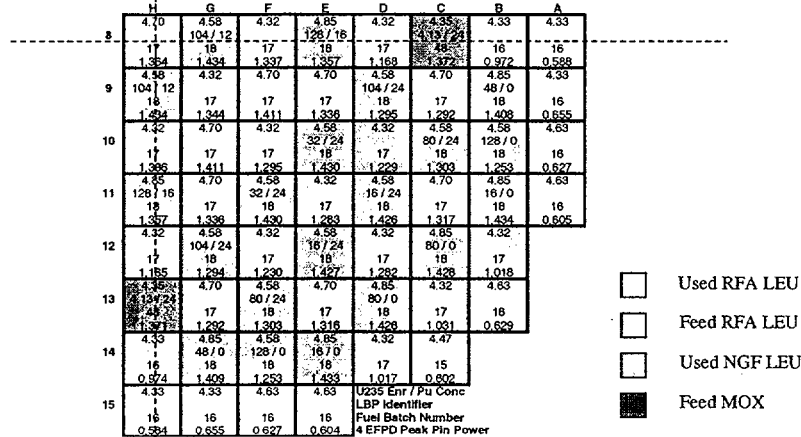
Irradiation and Examination



6



C1C16 Core Design



Required Regulatory Approvals

- Duke topical reports (thermal-hydraulic, nuclear analysis)
- AREVA topical reports (COPERNIC fuel performance, fuel assembly design, MOX fuel design)
- Duke license amendment request and exemption requests
- Duke security plan changes and exemption requests
- DOE export license application
- Duke Cogema Stone & Webster transportation package certifications



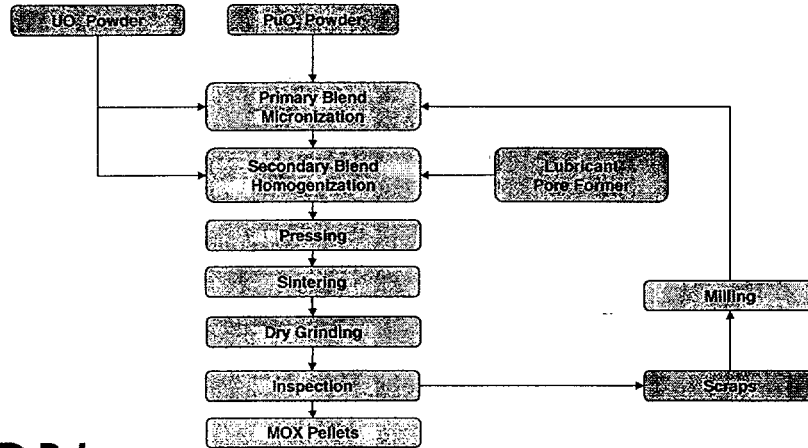
Outline of Presentation

- Introduction
 - ⇒ MOX fuel - general
- Safety evaluation
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- Summary

MOX Fuel Pellet Manufacturing

- **Micronized Master Blend (MIMAS) process**
- **Decades of experience in Belgium and France**
 - Plutonium from reprocessed reactor fuel
 - “Reactor grade” isotopics – more Pu-240 than weapons grade Pu
- **Pellet structure**
 - Uniform distribution of plutonium at a macroscopic scale
 - Heterogeneous microstructure at a micronic scale
 - Plutonium-rich particles (agglomerates)
 - Coating phase
 - UO₂ phase

MOX Fuel Pellet Manufacturing (MIMAS Process)



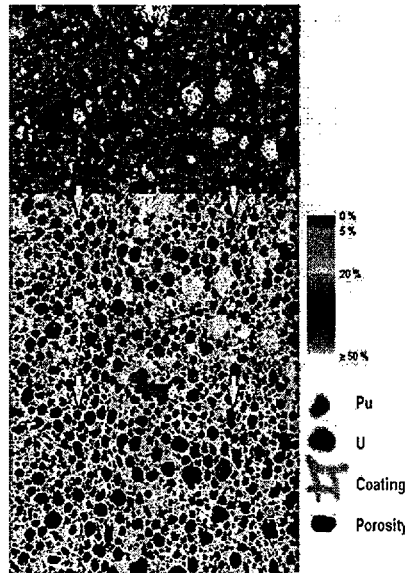
11



Unirradiated MIMAS MOX Fuel Microstructure EPMA: quantitative analysis of Pu distribution

As-measured image

After image analysis

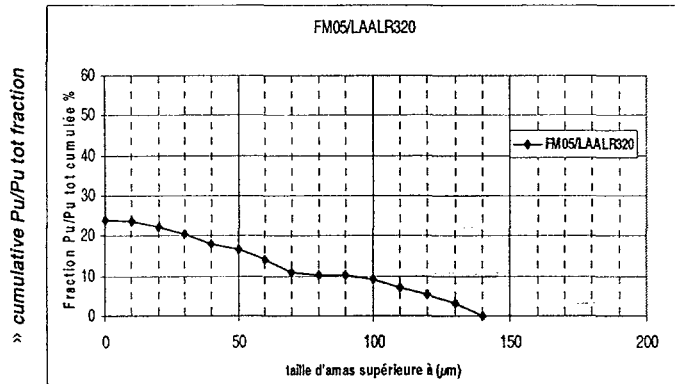


12



Cumulative Distribution of Plutonium

- $24 \pm 6\%$ in PuO_2 agglomerates
- $72 \pm 6\%$ in coating phase
- $4 \pm 1\%$ in UO_2 phase



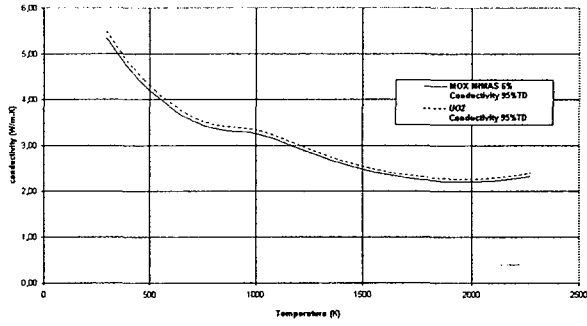
» agglomerate size larger than (μm)

Weapons Grade MOX Fuel Physical Characteristics

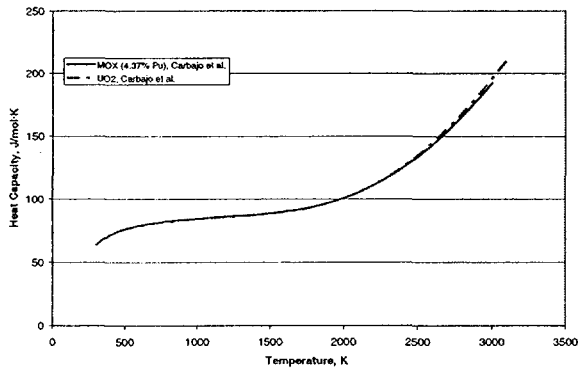
- Sintered ceramic oxide fuel pellets
- Predominantly (>95%) uranium
- Material properties similar to LEU fuel
- Lower decay heat than LEU during time frame of interest for transient/accident analyses
- Small impact on global core physics parameters and core radionuclide inventories
 - Four out of 193 assemblies
 - (~2% of core)

Thermal Conductivity

Thermal Conductivity, BU = 0

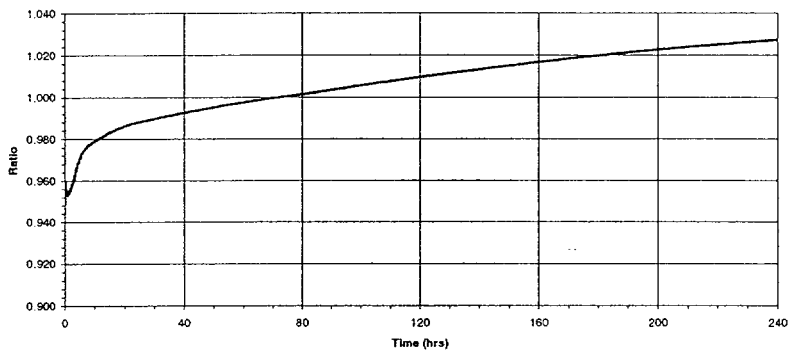


Heat Capacity



Decay Heat

Typical MOX/LEU Fuel Decay Heat Ratio



Global Core Physics Parameters

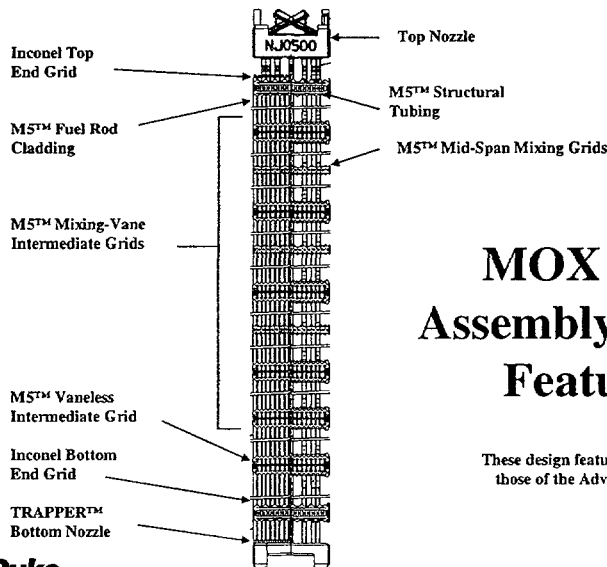
(% change due to four MOX fuel lead assemblies)

Parameter	BOC (4 EFPD)	EOC (495 EFPD)
Effective delayed neutron fraction	-2.1	-1.0
Prompt neutron lifetime	-1.8	-1.0
Equilibrium xenon worth	-1.1	-0.5
Hot full power mod temp coefficient	-3.0	-0.9
Hot full power Doppler coefficient	-0.7	0



MOX Fuel Lead Assembly Design Description

- Existing U.S. fuel assembly design with MOX fuel pellets: **Advanced Mk-BW/MOX1**
 - Advanced Mark-BW Fuel Assembly
 - The fuel assembly design is presented in BAW-10239, “Advanced Mark-BW Mechanical Design Topical Report”
 - Same assembly design (nozzles, grids, materials, etc. as has been successfully demonstrated in U. S. plants with uranium fuel pellets)
 - European MOX Technology, Experience, and Pellet Design
 - MOX effects are presented in BAW-10238, “MOX Fuel Design Report”



MOX Fuel Assembly Design Features

These design features are identical to those of the Advanced Mark-BW



Fuel Rods

Fuel Rod Parameters	MOX Lead Assembly	Advanced Mark-BW
Clad Material	M5 Alloy	M5 Alloy
Fuel Rod Length, in	152.40	152.16
Cladding OD, in	0.374	0.374
Cladding Thickness, in	0.0225	0.0225
Cladding ID, in	0.329	0.329
Clad-to-Pellet Gap, in	0.0065	0.0065
Fuel Pellet OD, in	0.3225	0.3225
Design Burnup, MWd/Mthm	60,000 Lead Assy 50,000 batch	62,000 batch



MOX Fuel Experience Base

- **Mature industrial-scale technology in Europe**
- **Substantial production capacity**
 - MIMAS: French (Melox) and Belgian (Dessel) plants
 - SBR: BNFL (Sellafield) plant beginning production
- **More than 3700 FAs delivered by Framatome ANP (France and Germany) as of the end of 2003**
- **More than 30 reactors in France, Germany, Belgium, and Switzerland are using MOX fuel**



MOX Fuel Performance Test Programs

- About 100 commercial fuel rods examined in hot cells (burnup up to 63 GWd/tHM, 5 cycles)
- Power ramp testing and instrumented analytical irradiations have been or are being carried out up to high burnups (national & international programs)
 - Pellet-cladding interaction
 - Fission gas release
 - Temperature
 - In-pile densification



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MOX Fuel Performance Test Program Results

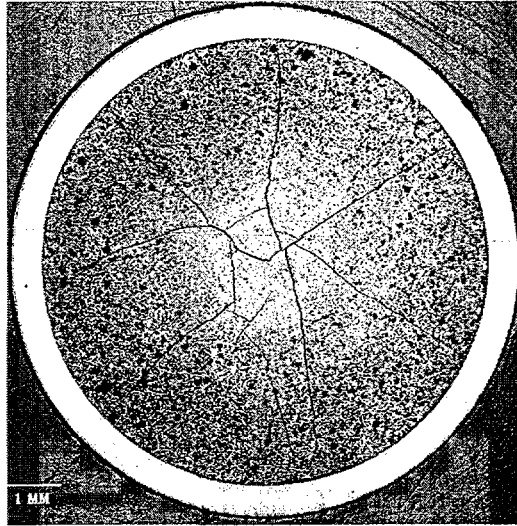
- Same behavior as LEU fuel in
 - Fuel rod growth
 - Cladding diametral deformation
 - Cladding waterside corrosion
 - Pellet solid swelling
 - ZrO₂ internal layer
 - Fission product activity and release from failed fuel
- Somewhat higher fission gas release than LEU fuel at higher burnup
- Better pellet-cladding mechanical interaction than LEU
- Results summarized in IAEA TecDoc 415



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Radial Cut of a MOX Pellet (50 GWd/tM)

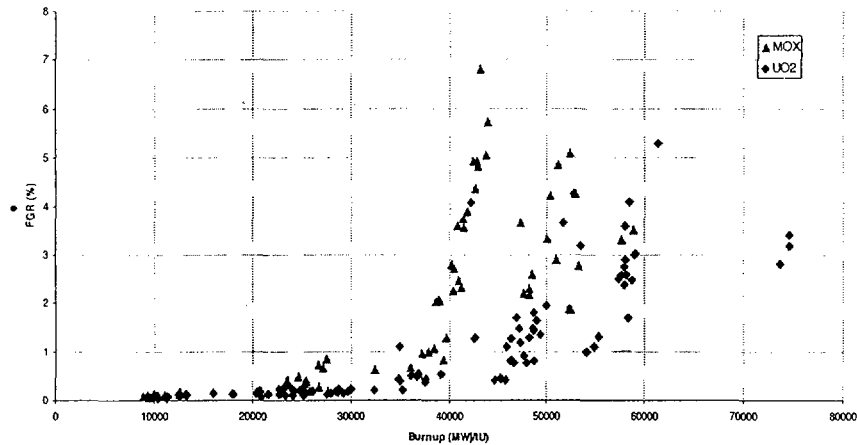


MOX Fuel Fission Gas Release

- **Higher MOX fuel temperature at medium-high burnups**
 - Neutronic properties: Higher linear heat rate at medium/high burnup
 - Physical properties: Slightly lower thermal conductivity
- **Pellet microstructure:**
 - Plutonium-rich particles from the MIMAS process
 - Local high burnup zones lead to the formation of dense pore populations
- **Differences in fission gas release at medium-high burnup**



Fission Gas Release of PWR Fuel Rods



Outline of Presentation

- Introduction
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Basis for Safe Operation with MOX Fuel

- Similar physical characteristics between LEU and MOX fuel
- Extensive European experience base with MOX fuel
- Similar to prior U.S. MOX fuel lead assembly programs
- Proven fuel assembly design
- Analyses and evaluations of MOX fuel impacts at Catawba



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LOCA Analyses

- Approach - Appendix K large break LOCA evaluation of MOX fuel lead assemblies
- Starting point – approved AREVA evaluation model based on RELAP5/MOD2-B&W
- Potential MOX effects were evaluated and incorporated in evaluation model as appropriate
- A MOX to LEU comparison calculation was performed
- Burnup and axial peaking studies were performed to establish LOCA limits for lead assemblies



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Potential MOX Effects

Parameter	Effect	LOCA MODEL
1. Thermal Conductivity	Small	MOX used
2. Volumetric Heat Capacity	Essentially none	LEU used
3. Decay Heat	120% of 1971 ANS 5.1 standard plus actinides is conservative	120% of 1971 ANS 5.1 standard plus actinides used
4. Void Reactivity	More negative than LEU	LEU appropriate for core loading
5. Delayed Neutron Fraction	Less than LEU fuel (Conservative for LOCA)	LEU appropriate for core loading
6. Initial Fuel Temperature	Small	MOX (COPERNIC) used



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Stylized MOX/LEU Comparison Analysis

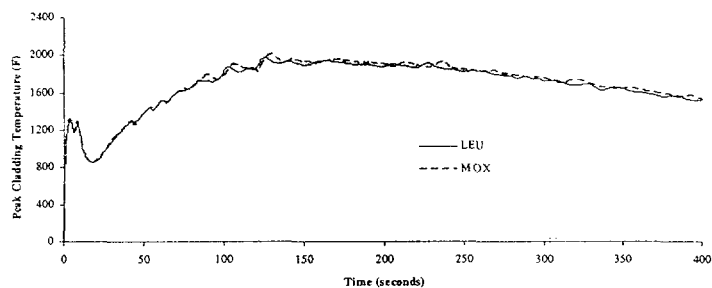
Parameter (Time-In-Life)	LEU (0 GWd)	MOX (0 GWd)
Total Peaking (F_Q)	2.4	2.4
PCT (°F) Pin #1 (2.3 % Pu)	1981	2018



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MOX/LEU Comparison



Other Criteria and Evaluations

- **All 10 CFR 50.46 criteria are met for large break LOCA**
 - Peak cladding temperature
 - Maximum cladding oxidation
 - Maximum hydrogen generation
 - Coolable geometry
 - Long-term cooling
- **Small break LOCA**
 - Not limiting for Catawba
 - MOX/LEU differences insignificant
- **No adverse MOX impact on LEU fuel (no mixed core penalty)**

LOCA Summary

- Specific evaluations were performed for MOX fuel lead assemblies using conservative Appendix K models appropriately adjusted for MOX fuel
- Analysis results were fundamentally similar to LEU fuel
- Sensitivity studies were performed on plant operating conditions
- Peaking criteria were established that ensure that MOX fuel remains within 10 CFR 50.46 acceptance criteria



35



Non-LOCA Evaluations

- Plant response to most non-LOCA design basis events is driven by global core physics parameters, system thermal-hydraulics, stored energy, and decay heat
 - Impact of four MOX fuel assemblies on global physics parameters is typical of cycle-to-cycle variations
 - System thermal-hydraulics are unaffected by MOX fuel
 - Four MOX fuel assemblies have no appreciable impact on stored energy
 - Decay heat is lower for MOX fuel during the time period of interest for transient analysis
- Some events require more detailed evaluation due to the potential for local effects



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Non-LOCA Evaluations of Specific Events

- **Control rod withdrawal or drop**
 - Location with control rods limiting
 - MOX not loaded under control rods in first two cycles
- **Steam line break**
 - Same as control rod withdrawal/drop
- **Control rod ejection**
 - Representative analyses indicate much less than 100 cal/g in MOX fuel
- **Fuel assembly misloading**
 - Prevention measures equally effective for MOX fuel
 - Detection more effective (MOX fuel preferentially loaded in instrumented locations)



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Non-LOCA Summary

- **The impact of four MOX fuel lead assemblies on most non-LOCA design basis events is clearly negligible**
 - Similar fuel design
 - Lower decay heat
 - Impact on global physics parameters in the noise of reload design
- **Events with potential local effects were evaluated in more detail**
 - Attributes of lead assembly program obviate most potential issues
 - Cycle-specific rod ejection analyses



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Radiological Consequences

- **SCALE analyses show that fission product inventories are similar between MOX fuel and LEU fuel**
 - Worst case ¹³¹I may be as much as 9% higher in a MOX fuel assembly compared to an equivalent LEU fuel assembly
 - Potential impact on thyroid and TEDE doses
- **Accidents involving numerous fuel assemblies should see no significant impact**
 - LOCA, rod ejection, and locked rotor assumed to fail 11%-100% of the fuel in the core
 - Lead assemblies are only 2% of the core
 - Postulated failures in non-MOX fuel assemblies dominate impacts



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Radiological Consequences (cont.)

- **Maximum impact seen in postulated accidents involving one or just a few assemblies**
 - Fuel handling accident (FHA) (one assembly)
 - Weir gate drop (WGD) (seven fuel assemblies)
- **Explicit FHA and WGD calculations performed using Alternate Source Term methodology**
 - MOX fuel-specific radionuclide inventories
 - Sensitivity study - Reg Guide 1.183 gap fractions increased 50% to reflect higher fission gas release from MOX fuel
- **Offsite and control room doses ~60% higher than all-LEU fuel case, but still well within regulatory limits**



40



MOX/LEU Dose Comparison (Weir Gate Drop)

Receptor	TEDE Dose Limit (Rem)	LEU Fuel (Rem)	MOX Fuel – Nominal Release Fractions (Rem)	MOX Fuel – +50% Gas Release Fractions (Rem)
EAB	6.3	2.2	2.3	3.5
LPZ	6.3	0.31	0.33	0.50
Control Room	5.0	2.1	2.2	3.3



Radiological Consequences Summary

- **Potential for dose impacts**
 - Different radionuclide inventories
 - Higher fission gas release from MOX fuel
 - Greatest impact for accidents involving a small number of assemblies
- **Explicit analyses of fuel handling and weir gate drop accidents**
 - Conservative treatment of MOX/LEU differences
 - Alternative Source Term methodology
 - Higher consequences in MOX fuel analyses, but well within regulatory limits



Outline of Presentation

- Introduction
- MOX fuel - general
- Safety evaluation
- ⇒ Environmental evaluation
- Summary



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Environmental Evaluation

- Assessment of potential MOX fuel lead assembly impacts on the environment
- Normal operations
 - No impact on effluents
 - Slight increase in fuel handling occupational dose
- Accident situations addressed in safety analyses and radiological consequence analyses



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Severe Accidents with Four MOX Fuel Lead Assemblies

- Evaluation based on DOE analysis of the impact of 40% MOX fuel cores on severe accident consequences
 - 1999 Surplus Plutonium Disposition Environmental Impact Statement
 - MOX-specific radionuclide inventories
 - Results scaled from 40% MOX fuel cores to lead assembly cores (2% MOX fuel)
 - Change in consequences relative to all-LEU core range from -0.2% to +0.7%, depending on accident sequence
- 2000 Lyman analysis
 - Scaled results indicate maximum adverse impact of 1.6% (includes worst case actinide release fractions)



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Severe Accidents - Summary

- Severe accident behavior will be driven by LEU fuel
- Any impact from MOX fuel lead assemblies (2% of the core) would be negligible
 - Overall uncertainties in light water reactor severe accident behavior
 - Other nuclear power plant changes with similar impacts are implemented without explicitly addressing severe accident consequences
 - Power uprates
 - Changes in cycle length



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Outline of Presentation

- Introduction
 - MOX fuel - general
 - Safety evaluation
 - Environmental evaluation
- ⇒ Summary



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The Big Picture

- **All nuclear power reactors are already using Pu fuel**
 - About 850 kg plutonium in Catawba LEU core at end of cycle (compared to ~80 kg in four lead assemblies)
 - About 50% core power from plutonium fissions at end of cycle
- **A similar MOX fuel lead assembly program was safely conducted at Ginna in the early 1980s**
- **European nuclear power reactors have demonstrated the safety of using MOX fuel**
 - More than thirty reactors in four countries over 25 years
 - Up to 36% core fractions
- **This program - 4 assemblies out of 193 (2.1% of core)**



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Intervener Issues

- **Interveners are contesting the MOX fuel lead assembly license amendment request**
 - Impact of MOX/LEU differences on LOCA and severe accidents
 - Failure to evaluate use of MOX fuel lead assemblies at Oconee
 - Security of fresh MOX fuel
- **Intervener issues have been addressed in license amendment request and ASLB filings**
- **Hearings scheduled for June and September 2004**
- **Fundamental issue – how much alleged “uncertainty” is acceptable?**



49



Conclusion

- **Duke license amendment request addressed potential MOX fuel lead assembly impacts on normal operations, the full range of design basis events, and severe accidents**
- **Regulatory limits are met**
- **No significant hazard to the public**



50



NRC STAFF REVIEW OF MIXED OXIDE LEAD TEST ASSEMBLIES AT CATAWBA NUCLEAR STATION

Robert E. Martin, Senior Project Manager
Undine Shoop, Reactor Systems Engineer
Ralph Landry, Senior Reactor Engineer
Anthony Attard, Senior Reactor Engineer
Steve La Vie, Health Physicist

Presentation for the
Advisory Committee on Reactor Safeguards
May 6, 2004

Presentation Message

- Licensee's Application of February 27, 2003, Followed by Numerous Supplements by Licensee.
- NRC Staff Safety Evaluation of April 5, 2004.
- NRC Staff Safety Evaluation found use of MOX LTAs acceptable on the basis of evaluations presented in that Safety Evaluation.
- Approval of application requires completion of other matters.
- Issue of Next Generation Fuel addressed by Licensee's letter of April 16, 2004, is under NRC staff review.



SRXB Review of the Mixed Oxide Fuel Lead Test Assemblies

**Meeting with ACRS
May 6, 2004**

**Undine Shoop
U.S. Nuclear Regulatory Commission**



Purpose

- **Discuss Areas of Staff Review**
 - **Thermal Mechanical Design**
 - **Data Collection**
 - **Nuclear Design**
 - **Non-LOCA Transient Analysis**
 - **LOCA**

May 6, 2004

FL-2



Purpose of an LTA

- **Gather data on fuel performance**
- **Based on production design**
- **Pre-characterized**
- **Examined between irradiation cycles and after discharge**
- **Basis for improved fuel designs and analytical models**

May 6, 2004

FL-3



Thermal Mechanical Design

Undine Shoop



Fuel Assembly Design

- **Lead Test Assembly (LTA)**
 - **Licensing framework is SRP Section 4.2**
- **Design Evaluation is provided in BAW-10238**

May 6, 2004

FL-2



Framatome MOX vs LEU Fuel Assembly Design Differences

- **Longer fuel rod**
- **European dish and chamfer designs**
- **95% theoretical density**
- **Use of Mixed Oxide for fissile material**

May 6, 2004

FL-3



Mixed Oxide Fuel

- **Depleted Uranium matrix with weapons grade Plutonium fissile material**
- **Significance of Isotopic Mixture**
 - **Fewer absorber isotopes**
 - **Increased fissile isotopes**
 - **Lower enrichment requirement for comparable reactivity than reactor grade MOX**

May 6, 2004

FL-4



Gallium

- **Has the potential to migrate to the cladding and embrittle the cladding**
 - **Removed through polishing**
 - **ORNL tests on gallium migration**
 - **300 ppb limit for plutonium feed material**

May 6, 2004

FL-5



Data Collection Program

Undine Shoop



Data Collection Program

- **Purposes**
 - **Neutronic – Startup Physics Testing**
 - **Fuel Behavior – Post Irradiation Examinations (PIEs)**

May 6, 2004

FL-2



Neutronic

- **2 LTAs will be located in core locations that are directly measured by movable in-core detectors for the first and second irradiation cycles**
- **Operating Data from the cycle**
 - **Measurements taken monthly**
 - **Used to verify CASMO-4/SIMULATE-3MOX**
- **Start up Physics Test Plan**

May 6, 2004

FL-3



PIE

- **Poolside PIE**
 - **Performed between cycles**
- **Poolside PIE**
 - **Performed after assembly discharge**
- **Hot Cell PIE**

May 6, 2004

FL-4



Nuclear Design

Undine Shoop



Neutronic Impact of LTAs

- **4 LTAs and 189 other assemblies**
- **Insignificant impact on core wide neutronic behavior**

May 6, 2004

FL-2



Core Design

- **Checkerboard Pattern**
- **LTAs in symmetric core locations**
- **Unrodded locations**
- **LTAs are not limiting, but are in prototypical locations**

May 6, 2004

FL-3



Key Core Physics Parameters

May 6, 2004

FL-4



Key Core Physics Parameters

EFPD	POWER (percent)	BORON (ppm)			MAX ASSY POWER 2RPF			2-D PEAK PIN POWER 2PIN		
		MOX	LEU	DELTA	MOX	LEU	DELTA	MOX	LEU	DELTA
0	0	1832	1815	17	1.407	1.334	0.073	1.557	1.498	0.059
4	100	1242	1235	7	1.291	1.284	0.007	1.426	1.423	0.003
12	100	1224	1218	6	1.272	1.277	-0.005	1.411	1.418	-0.007
25	100	1234	1230	4	1.272	1.275	-0.003	1.416	1.420	-0.004
50	100	1260	1258	2	1.270	1.270	0.000	1.421	1.421	0.000
100	100	1249	1250	-1	1.321	1.317	0.004	1.401	1.397	0.004
150	100	1170	1173	-3	1.345	1.340	0.005	1.414	1.409	0.005
200	100	1046	1051	-5	1.357	1.353	0.004	1.430	1.425	0.005
250	100	892	898	-6	1.373	1.365	0.008	1.437	1.431	0.006
300	100	720	728	-8	1.375	1.366	0.009	1.435	1.425	0.010
350	100	537	545	-8	1.361	1.354	0.007	1.420	1.413	0.007
400	100	350	359	-9	1.339	1.332	0.007	1.395	1.388	0.007
450	100	164	173	-9	1.313	1.307	0.006	1.368	1.362	0.006
470	100	91	100	-9	1.302	1.297	0.005	1.357	1.351	0.006
490	100	19	28	-9	1.293	1.289	0.004	1.347	1.342	0.005
495	100	1	10	-9	1.291	1.287	0.004	1.344	1.340	0.004

April 21, 2004

FL-6



Key Core Physics Parameters

EFPD	POWER (percent)	BORON (ppmb)	ITC (pcm/°F)			MTC (pcm/°F)		
			MOX	LEU	DELTA	MOX	LEU	DELTA
0	100	1832	-8.48	-8.05	-0.43	-7.03	-6.60	-0.43
0	0	1832	-3.47	-3.10	-0.37	-1.76	-1.40	-0.36
4	100	1242	-13.84	-13.47	-0.37	-12.40	-12.04	-0.36
4	0	1242	-8.15	-7.85	-0.30	-6.46	-6.18	-0.28
200	100	1046	-18.34	-17.95	-0.39	-16.85	-16.47	-0.38
200	0	1046	-10.90	-10.60	-0.30	-9.18	-8.89	-0.29
495	100	1	-37.56	-37.25	-0.31	-35.92	-35.61	-0.31
495	0	1	-26.47	-26.25	-0.22	-24.66	-24.43	-0.23
EFPD	POWER (percent)	BORON (ppmb)	DOPPLER (pcm/°F)			DIFF BORON WORTH (pcm/ppm)		
			MOX	LEU	DELTA	MOX	LEU	DELTA
0	100	1832	-1.45	-1.45	0.00	-6.19	-6.30	0.11
0	0	1832	-1.71	-1.70	-0.01	-6.54	-6.68	0.14
4	100	1242	-1.44	-1.43	-0.01	-6.30	-6.40	0.10
4	0	1242	-1.69	-1.67	-0.02	-6.66	-6.78	0.12
200	100	1046	-1.49	-1.48	-0.01	-6.49	-6.56	0.07
200	0	1046	-1.72	-1.71	-0.01	-6.82	-6.89	0.07
495	100	1	-1.64	-1.64	0.00	-7.94	-8.01	0.07
495	0	1	-1.81	-1.82	0.01	-8.28	-8.35	0.07

Note: Boron concentrations in this table are for a representative core with MOX fuel lead assemblies. Table 3-7 has the corresponding boron concentrations for an all-LEU core.

April 21, 2004

FL-8



Non - LOCA Transients

Undine Shoop



Non-LOCA Transients

- **Deterministic Licensing application - addresses Chapter 15 transients**
- **Normal reload process used**
- **Confirm that all physics parameters fall within reference values previously calculated**

May 6, 2004

FL-2



Control Rod Ejection

- **Core loading Pattern precludes significant impact of RIA**
 - **LTAs in unrodded locations**
 - **LTAs not close to fuel assemblies having significant ejected control rod worth**
- **Peak LEU enthalpy of 54 cal/g**
- **Peak MOX enthalpy of 30 cal/g**

May 6, 2004

FL-3



Fuel Assembly Misloading

- **Administrative measures**
- **Core power distribution measurements**

May 6, 2004

FL-4



Catawba MOX LTA LOCA

Ralph R. Landry
Reactor Systems Branch, NRR
May 6, 2004

RRL-1



MOX LTA LOCA

- Analysis of Record – Resident Fuel + Sensitivity Studies

- MOX LTA LOCA Analyses

RRL-2

MOX LTA LOCA

- Analysis of record is Westinghouse WCOBRA/TRAC Realistic LBLOCA
- Resident fuel assemblies are Westinghouse Robust Fuel Assemblies (RFA)

RRL-3

MOX LTA LOCA

- Analysis of record covers Mark-BW fuel by sensitivity study use of a surrogate, or proxy, assembly with pressure drop representative of Mark-BW assembly
- Mark-BW/MOX1 assembly pressure drop is closer to Westinghouse RFA than to Mark-BW fuel

RRL-4

MOX LTA LOCA

- MOX LTA LOCA response calculated using Framatome ANP Appendix K code, RELAP5/MOD2-B&W
- Approved code includes approved properties of M5 cladding

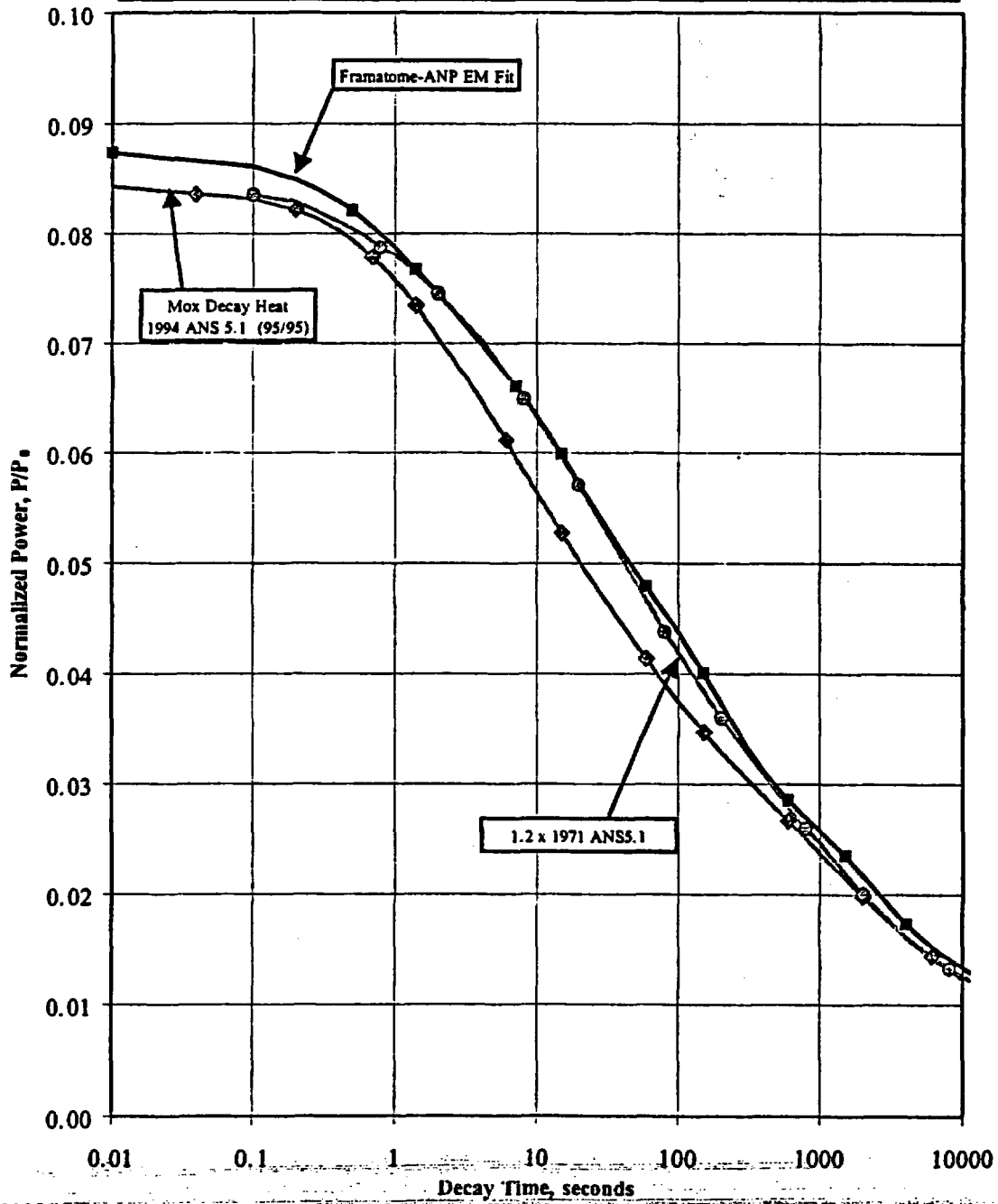
RRL-5

MOX LTA LOCA

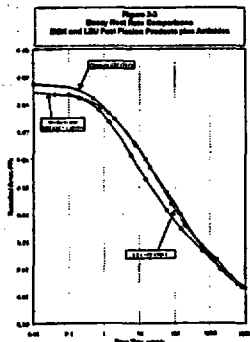
- Decay heat model used, ANSI/ANS-5.1-1994, is applicable since highly burned LEU fuel produces the majority of its energy from the fission of plutonium. Multiplier of 1.2 is used to cover uncertainties (Figure 3-3)

RRL-6

Figure 3-3
Decay Heat Rate Comparisons
MOX and LEU Fuel Fission Products plus Actinides



MOX LTA LOCA



RRL-7

MOX LTA LOCA

- Δ PCT for MOX LTA vs. RFA LEU is -38°F, or 2018°F for the MOX LTA vs. 2056°F for the RFA LEU
- MLO for MOX LTA is 4.5% vs. RFA 10%
- MOX LTA placement is in non-limiting locations

RRL-8

MOX LTA LOCA


	RFA LEU WCOBRA/TRAC	Mk-BW/MOX1 MOX RELAP5/M2- B&W	Mk-BW/MOX1 LEU RELAP5/M2- B&W
PCT	2056°F	2018°F	1981°F
MLO	10%	4.5%	4.0%

RRL-9

MOX LTA LOCA

- Staff concludes that MOX LTAs will comply with requirements of 10 CFR 50.46 when inserted in core of Westinghouse RFA LEU fuel


RRL-10



Union of Concerned Scientists
Science and Standards for Environmental Stewardship

USE OF MIXED-OXIDE LEAD TEST ASSEMBLIES AT CATAWBA


Presentation to NRC Advisory Committee on Reactor Safeguards
 Edwin Lyman
 Union of Concerned Scientists
 May 6, 2004



Union of Concerned Scientists
Science and Standards for Environmental Stewardship

BREDL INTERVENTION ON MOX LTA REQUEST


- UCS is assisting the Blue Ridge Environmental Defense League (BREDL) in its challenge of Duke's MOX LTA LAR and security exemption request
- Security-related contentions
 - conducted in closed (safeguards) proceeding
- Non-security-related contentions (safety and environmental)



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MOX LTA HEARING

- ASLB admitted three (reframed) non-security-related contentions on 3/5/04
- Duke wants NRC to issue the LTA license amendment and security exemptions by early August 2004
 - Timetable is driven by DOE/NNSA's desire for a decision prior to shipment of plutonium to France for LTA fabrication at Cadarache (before plant shuts down)
 - ASLB attempt to accommodate this request is resulting in a highly compressed adjudicatory proceeding



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Science and Standards for Environmental Stewardship

MOX LTAs: THE BIG PICTURE

- Issues that are resolved only by virtue of the small number of MOX LTAs in the core will need to be reconsidered when the batch loading application is received next year
- US approval process for MOX LTA LA and security exemptions will set an example for Russian counterpart
- Thorough review should take place now



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DUKE SECURITY EXEMPTION REQUEST

- 9/15/03 security exemption request:
 - Rationale: Several requirements in 10 CFR §73.45 and §73.46 are "impractical and unnecessary to assure the security of any MOX fuel assemblies"
 - These sections pertain to physical protection systems for protecting formula ("Category I") quantities of strategic special nuclear material from the design basis threats of theft and sabotage
 - Details are provided in seven attachments, much of which NRC has determined contains Safeguards Information



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SECURITY EXEMPTION REQUEST (cont.)

- "Duke Power maintains that ... its security request is reasonable, given the difficulty of diverting plutonium contained in the bulky fuel rods ..." ---
 "Nuclear Security Decisions are Shrouded in Secrecy," R. Jeffrey Smith, The Washington Post, March 29, 2004.



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NRC MOX LTA SECURITY REVIEW PLAN

- Earlier this year, NRC publicly released a plan providing guidance to NRC staff who will perform safeguards and security reviews of license applications to possess and use MOX fuel in a power reactor (memo from J. Shea to G. Tracy, January 29, 2004)



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Scientists

MOX SECURITY REVIEW PLAN (cont.)

- "...the staff's assessment is that the MOX material, while meeting the criteria of a formula quantity, is not attractive to potential adversaries from a proliferation standpoint due to its low plutonium concentration, composition and form."
- "A large quantity of MOX fuel and an elaborate extraction process would be required to accumulate enough material to fabricate an improvised nuclear device or weapon."
- Cites 1989 exemption from Category I requirements for fresh fuel containing highly enriched uranium for the Fort St. Vrain gas-cooled reactor



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FLAWS IN MOX SECURITY REVIEW PLAN

- Assertion that MOX assemblies require less protection than plutonium is inconsistent with
 - International Convention on Physical Protection
 - IAEA guidance INFCIRC/225 (Rev. 4)
 - U.S.-Russian Plutonium Disposition Agreement
 - National Academy of Sciences recommendation ("stored weapons standard")
- Fort St. Vrain security exemption has little relevance to the MOX exemption request
 - SNM content much lower than in a MOX assembly
 - Extracting HEU from GCR fuel much harder than separating Pu from a MOX assembly



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CONTENTION I

- Reframed (Non-security) Contention I: Duke has failed to adequately account for differences in MOX and LEU fuel behavior with regard to LOCAs and other DBAs
- Issues:
 - Fuel-related phenomena that may affect compliance with ECCS criteria for MOX LTAs
 - M5 cladding-related phenomena that may affect compliance with ECCS criteria for MOX LTAs
- Fundamental problem: Uncertainties due to gaps in experimental database for MOX under LOCA conditions
 - IRSN proposal for Phébus MOX DB-LOCA test



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FUEL RELOCATION DURING LOCA


- Temperature effect of fuel relocation during a LOCA (collapse of fuel fragments following clad ballooning) not considered in Appendix K
- IRSN: Fuel relocation may
 - Increase peak cladding temperature (PCT) by 30°C (54°F) to 180°C (324°F), depending on filling ratio
 - Increase local clad oxidation by up to 10%
- Taking relocation into account may be more important for M5-clad MOX than for LEU
 - smaller margin for MOX (higher temperature)
 - M5 forms bigger balloons (greater ductility)
 - Impact of MOX fragmentation behavior on filling ratio unknown - but medium-burnup (45-50 GWD/t) MOX may be more susceptible to relocation than medium-burnup LEU fuel
 - Impact of differences in fuel-clad bonding unknown



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FUEL RELOCATION


- Results of Duke large-break LOCA calculation from LAR
 - PCT: 2018°F for MOX; 1981°F for LEU
- An average increase of 105°C (190°F) from relocation effects would bring the MOX PCT well over the regulatory limit of 2200°F



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Climate and Security for Environmental Justice

M5 CLADDING ISSUES


- Vulnerability of zirconium-niobium alloy claddings (E110, M5) to embrittlement appears to be a function of initial surface treatment (polishing vs. etching)
 - Argonne oxidation test on etched M5 samples "showed a potential similarity to the oxide characteristics of alloy E-110" — letter from James F. Mallay, Framatome ANP, to Ralph Meyer, RES, May 5, 2003
 - "... parallel testing at Argonne on unirradiated ZIRLO and M5 tubing has shown significant differences compared with Zircaloy." — letter from A. Thadani, NRC, to D. Modreen, EPRI, April 21, 2004
 - Raises questions regarding stability of M5 with respect to production conditions, changes under irradiation, corrosion, hydrogen uptake (see Updated Program Plan for High-Burnup LWR Fuel, August 2003)



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Climate and Security for Environmental Justice

CONTENTION II


- Reframed (Non-security) Contention II: Duke has failed to adequately account for differences in MOX and LEU fuel behavior with respect to radionuclide releases during "core disruptive accidents"
- Issues (see Expert Panel Report on High-Burnup and MOX Source Terms, ERI/NRC 02-0202, Nov. 2002):
 - Different degradation behavior of MOX
 - Enhanced release rates of some radionuclides from MOX
 - Current source term underestimates release fractions of tellurium and ruthenium isotopes (inventories greater in MOX)
- Fundamental problem: Uncertainties due to gaps in experimental database for MOX under core melt conditions
 - IRSN proposal for Phébus MOX source term test



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CONCLUSIONS

- Much research is needed to reduce the uncertainties in M5 cladding and MOX fuel performance during LOCAs and severe accidents
 - ANL LOCA tests with irradiated M5-clad fuel LEU
 - Halden fuel relocation test (LEU)
 - Proposed Phébus MOX LOCA and source term tests
- More uncertainty introduced by Duke's plan to load another type of experimental fuel simultaneously with the MOX LTAs
- BREDL/UCS maintains that experimental data is insufficient to support approval of Duke's MOX LTA LAR at this time



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CONCLUSIONS (cont.)

- Duke has not demonstrated adequately that the introduction of 4 MOX LTAs will have only an insignificant impact on risk
 - Duke should do its own risk calculation, rather than rely on a DOE estimate
 - Duke should examine impact of source term uncertainties on result
 - Duke's comparison of the increase in risk to that associated with other license amendments such as power uprates is not valid, because the "benefits" are different in each case
- Contrary to Duke's assertion, BREDL is not seeking "absolute certainty" but only "reasonable assurance" that the MOX LTA program will provide adequate protection of public health and safety

Risk Management Technical Specifications

**Presentation to the
Advisory Committee on Reactor
Safeguards
May 6, 2004**

Presentation Participants

- NRC Staff
 - Tom Boyce, NRR TS Section
 - Bob Tjader, NRR TS Section
 - Mark Reinhart, NRR PRA Section
 - Nick Saltos, NRR PRA Section
- Industry Representatives
 - Biff Bradley, NEI
 - Wayne Harrison, STP
 - Bill Stillwell, STP

Opening & Closing Comments

- RMTS Initiative 4b is dependent upon PRA Quality
- Communication and Training of HQ Staff & Regions are essential; Initiative 4b is participating in the Risk-Informed Environment Initiative
- Early in the Initiative 4b Process; Learn as we go forward

FEEDBACK FROM SUBCOMMITTEES

- Comments:
 - Good idea to Risk-inform TS
 - Structure of Initiative 4b is good
- Issues:
 - Configuration Risk Monitors and Assessment Tools
 - Extent of PRA Incorporation
 - QA/QC of software & updates
 - Uncertainty and impact on CTs/AOTs
 - Licensee incentive to fix problems within CT
 - Review Risk associated with Front Stops
 - Time to calculate risk
 - Oversight of changes to PRA after Initiative 4b issued

Principles for RMTS Development

- Achieve coherence with other risk-informed regulation development (MRule, PRA Quality, 50.69)
- Credit for 50.65(a)(4) programs in RMTS Initiatives
- Licensee's risk submittals must meet standards for quality and comprehensiveness
- Involve NRC staff with cognizance for operation, training, inspection, maintenance, regions/STA, and risk assessment

STATUS OF INITIATIVES

- Reliance on existing (a)(4) Program
 - Initiative 2: Missed Surveillances (NRC Approved)
 - Initiative 3: Mode Change Flexibility (NRC Approved)
- Analysis of Specific Plant Configurations
 - Initiative 1: Modified End States (1 yr)
 - Initiative 6: LCO 3.0.3 Action Times (1 yr)
 - Initiative 7: Non-TS Support System Operability (1 yr)
- Quantitative Risk Assessment / Quality PRA
 - Initiative 4: Flexible Completion Times (2 yrs)
 - Initiative 5: Surveillance Frequency Program (2 yrs)
- Rulemaking
 - Initiative 8: Relocate non-risk significant systems from TS (3+yrs)

Initiative 4 – Risk-Informed Completion Times

- **Effect:** Extend completion time from a nominal value up to a predetermined “backstop” maximum using configuration risk management
- **Basis:** Under development, to include approved process, requirements for PRA technical adequacy, real-time quantitative capability, configuration and cumulative risk metrics
- **Status:** Industry submitted draft guidance document & pilot proposals; staff provided feedback. STP & Fort Calhoun are pilots. Hope Creek has formally volunteered to be pilot.

Initiative 4b Example

- See proposed 4b Tech Spec; discuss concepts
- Initiative 4b concepts
 - Front Stop; current CT
 - CRMP-based CT
 - Back Stop
 - Use of Real-Time Risk Assessment Tools and Decision Making Process

**TABLE 3-1
GENERIC RISK-INFORMED CTs WITH A BACK-STOP: EXAMPLE FORMAT**

Actions Condition	Required Action	Completion Time
B. One [HPSI] subsystem inoperable.	B.1 Restore SI subsystem to OPERABLE status.	72 hours
	<u>OR</u>	
	B.2.1 Determine that the completion time extension beyond 72 hours is acceptable in accordance with established RMTS thresholds.	72 hours
	<u>AND</u>	
	B.2.2 Verify completion time extension beyond 72 hours remains acceptable.	In accordance with the RMTS Program (i.e., within 24 hours of a subsequent configuration change)
	<u>AND</u>	
	B.2.3 Restore subsystems SI to OPERABLE status.	30 days or acceptable completion time, whichever is less.

POTENTIAL IMPLEMENTATION STRUCTURE

- Program Requirements in Technical Specifications Administrative Controls
 - PRA Quality (RG 1.200)
 - Guidance Documents (RG 1.177+, RMG)
- Licensee Program Guidance
- Oversight

RMTS INITIATIVE 4b and PRA QUALITY

- Use of “Real-time” PRA results to determine Completion Times is a significant change to Technical Specifications
 - Licensee’s use of PRA
 - NRC Review & Oversight
- PRA model must be of High Quality (scope, elements, and technical attributes)
- Configuration Risk Management process and tool must be of High Quality

Pilots for PRA Quality and Initiative 4b

- PRA Quality (RG 1.200) pilot program in parallel with RMTS Initiative 4b pilot program
- RG 1.200 Pilot Plants: SONGS, CGS, STP, Limerick
- 4 of 5 Pilot Applications of RG-1.200 involve Technical Specification Amendments
- RMTS Initiative 4b Pilot Plants: STP, FCS, Hope Creek
- STP is a Pilot for both RG 1.200 and RMTS Initiative 4b
- Pilots to test:
 - Reg Guide (RG-1.200) ability to prove adequate PRA Quality
 - Necessary scope of PRA
 - Internal Fire + External Events + Shutdown & Transition Risk
 - Software for Configuration Risk Management Tool
 - Configuration Risk Management Process

CURRENT REVIEW ISSUES

- Exportability; Pilot Plant General Acceptance Criteria
 - Reliability
 - Repeatability
 - Enforceability/Oversight
- PRA Quality (proof of concept)
 - Scope
 - Level of Detail
 - Acceptability

Opening & Closing Comments

- RMTS Initiative 4b is dependent upon PRA Quality
- Communication and Training of HQ Staff & Regions are essential; Initiative 4b is participating in the Risk-Informed Environment Initiative
- Early in the Initiative 4b Process; Learn as we go forward



Risk Management Technical Specifications Initiative 4B

Biff Bradley

May 6, 2004



Foundation

- Maintenance rule (a)(4) provision implemented November 1999
 - Resulted in both deterministic (TS) and risk management (MR) regulatory requirements for plant configuration control – sometimes in conflict
 - MR risk assessment and management guidance developed with recognition that TS provided “backstop”
 - NRC recognized that MR could provide foundation for additional TS reform

Objectives

- Better align deterministic tech specs with risk management approach required by maintenance rule
- Make changes within existing tech spec framework and practice
- Maintain operator safety focus and ease of use
- Provide incentive for improved PRAs and configuration risk assessment tools

Initiative 4B approach

- Would apply to all equipment LCOs
 - Not applicable to parameters, safety limits
- Maintains existing LCO as “front stop”
 - Operator familiarity
 - Approaching front stop would trigger more extensive risk evaluation and actions
- Deterministic backstop would be established
 - 30 days irrespective of risk impact
- Actual completion times would be based on risk assessment and management using NRC approved risk management guidance

Pilot Plants

- South Texas Project (whole plant)
- Hope Creek (whole plant)
- Ft. Calhoun (system specific)
- Additional plants interested
 - All would incorporate EPRI risk management guidance method through reference in Tech Specs

Risk management guidance for 4B

- Developed by EPRI
 - Builds on existing (a)(4) guidance
 - More rigor in risk analysis, risk management actions, plant shutdown decisions
 - PRA scope and capability requirements
- One round of NRC review/feedback complete
 - 75 NRC questions posed and addressed
 - Iterative process to complete development
 - Will be finalized through pilot plant process

PRA requirements – proposed for 4B

- Minimum PRA and tool requirements
 - Internal events and LERF, NRC Reg Guide 1.200 (ASME standard)
 - External events at power (including seismic, internal fires)
 - Ability to quantify configuration risk
 - Ability to determine and track aggregate risk
 - Updating requirements



Risk assessment metrics

- Establish for:
 - Planned evolutions
 - Emergent conditions
- Guidance will address use of:
 - Temporary risk increase (ICDP)
 - Risk “speed limit” (CDF limit)
 - Cumulative risk (Δ CDF)

Risk management

- Actions based on risk metric results
- Examples
 - Existing tech spec actions
 - Planning and sequencing of activities
 - Training, prestaging of maintenance
 - Limit duration of maintenance
 - Provide for rapid recovery of equipment
 - Prohibit maintenance on opposite train
 - Shut down plant (emergent condition)

Conclusions

- Challenging risk application
- Risk management guidance is work in progress
- Pilot applications will enable further development and detail in guidance
- Goal is NRC endorsement at appropriate level of detail



STP Risk-Informed Technical Specifications Application

Advisory Committee on Reactor Safeguards

May 6, 2004

Introduction

- STP Participants
 - Bill Stillwell Risk Management Supervisor
 - Wayne Harrison Licensing

Agenda

- Scope and content of the STP application
- STP PRA Quality (RG 1.200 Pilot)
- Implementation

Scope and Content

- Industry pilot for risk-informed Technical Specifications using configuration risk management
- Applies STP's Maintenance Rule (a)(4) approach to determine configuration based allowed outage times.
 - References the EPRI Implementation Guidelines
- Pilot application for PRA Quality RG 1.200

Scope and Content

- Current Technical Specification structure and format retained
- Allows operators to use risk management option to determine allowed outage time when the existing allowed outage time or “frontstop” time is exceeded
- Imposes a “backstop” time to return inoperable equipment to service

Scope and Content

- Selected instrumentation of TS 3.3
- Code safety valves
- Pressurizer PORVs
- Accumulators
- ECCS
- RHR
- RWST
- RCB Purge
- Containment Isolation Valves
- Containment Spray
- Containment Fan Coolers
- AFW
- MSIVs
- MFIVs
- Atmospheric Steam Relief
- Component Cooling Water
- Essential Cooling Water
- Essential Chilled Water
- SDGs and Off-site circuits
- Batteries
- ESF Buses

Draft TS 3.13.1

RISK MANAGEMENT

ALLOWED OUTAGE TIME DETERMINATIONS

LIMITING CONDITION FOR OPERATION

3.13.1 When referred to this specification, equipment that has been removed from service or declared inoperable shall be evaluated for its impact on plant risk and allowed outage times determined accordingly.

APPLICABILITY: As required by the referencing specification

ACTION:

Determine that the configuration is acceptable for Completion Time extension beyond the [Front Stop AOT],

AND

Determine that the configuration is acceptable for continued operation beyond the [Front Stop AOT] whenever configuration changes occur that may affect plant risk,

AND

Restore required inoperable [subsystem, component] to OPERABLE status within the Acceptable Allowed Outage Time Extension or 30 days, whichever is shorter.

OR

Take the ACTION required in the referencing specification for required action or completion time not met

SURVEILLANCE REQUIREMENTS

4.13.1: As required by the referencing specification

Sample Specification

PLANT SYSTEMS

3/4.7.4 ESSENTIAL COOLING WATER SYSTEM

LIMITING CONDITION FOR OPERATION

3.7.4 At least three independent essential cooling water loops shall be OPERABLE.

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTION:

- a. With only two essential cooling water loops OPERABLE, within 7 days restore at least three loops to OPERABLE status or apply the requirements of Specification 3.13.1, OR be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.
- b. With two or more essential cooling water loops inoperable, within 1 hour restore at least two loops to OPERABLE status or apply the requirements of Specification 3.13, OR be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

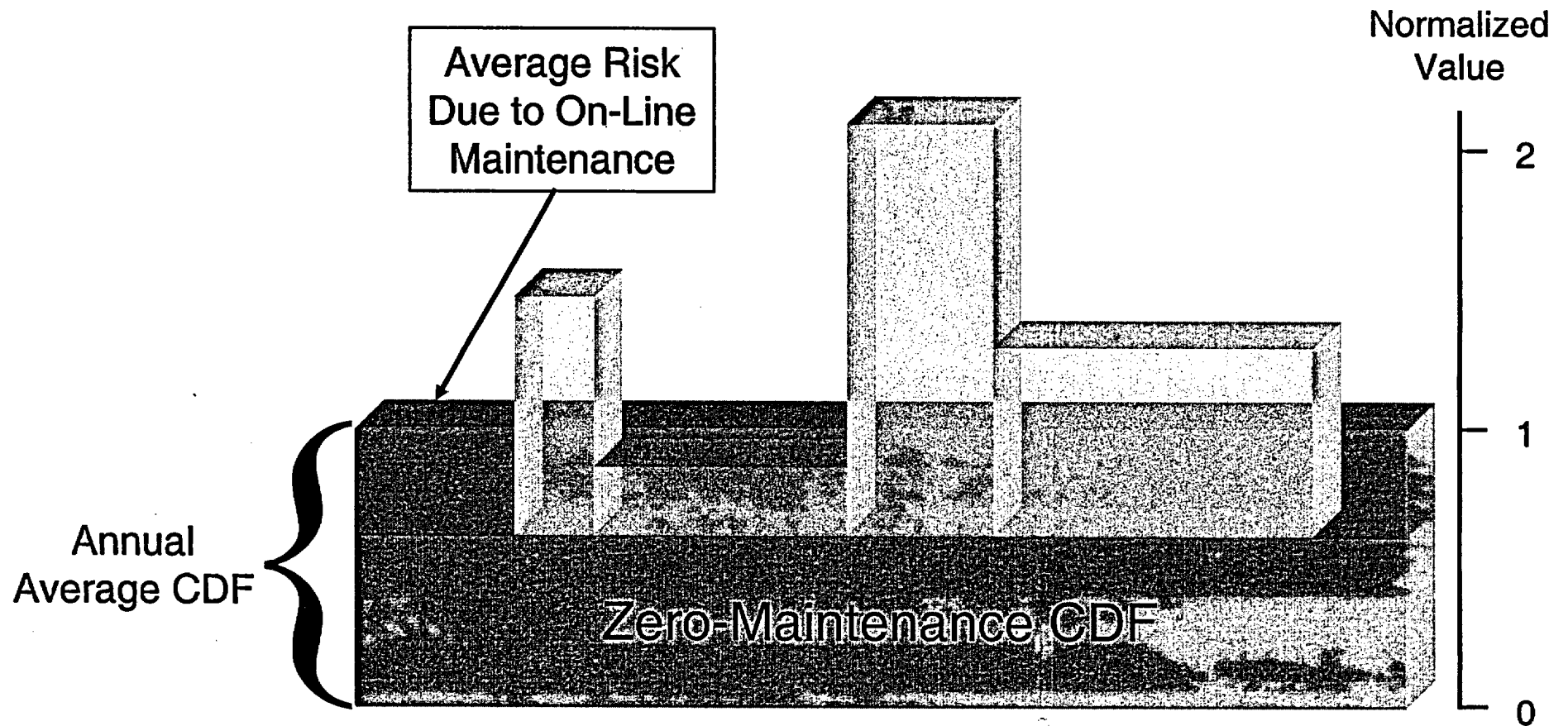
STP PRA Quality

- PRA quality issues to be addressed as part of the RG 1.200 pilot
- PRA quality scope to include industry peer review, ASME Standard (ASME RA-S-2002), and RG 1.200
- PRA quality needed for the application itself will also be evaluated.

Implementation

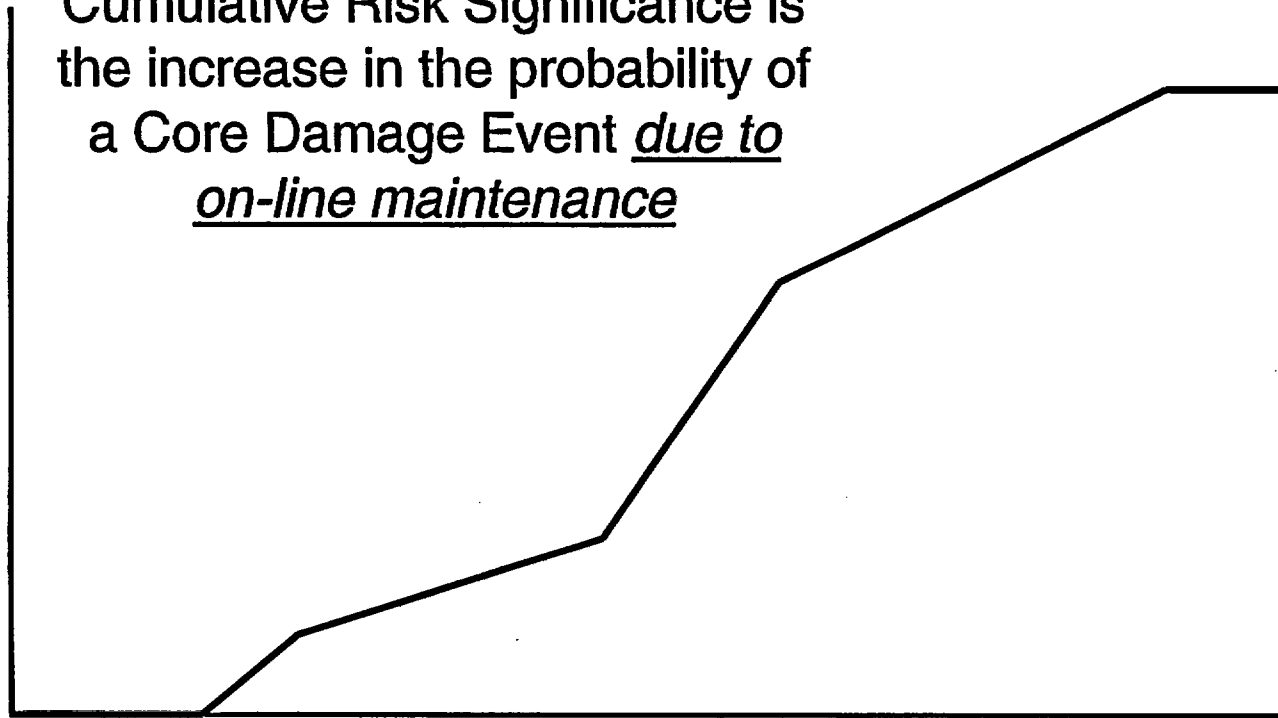
- Applies the STPNOC Configuration Risk Management Program (CRMP)
 - Same program used for 10CFR50.65(a)(4)
 - Non-risk significant threshold (1E-06)
 - Potentially risk-significant threshold (1E-05)
- STP has extensive experience applying the CRMP
 - Routinely used to manage weekly work
 - Effectively applied to manage recent extended diesel generator outage.

How Risk Values Stack Up

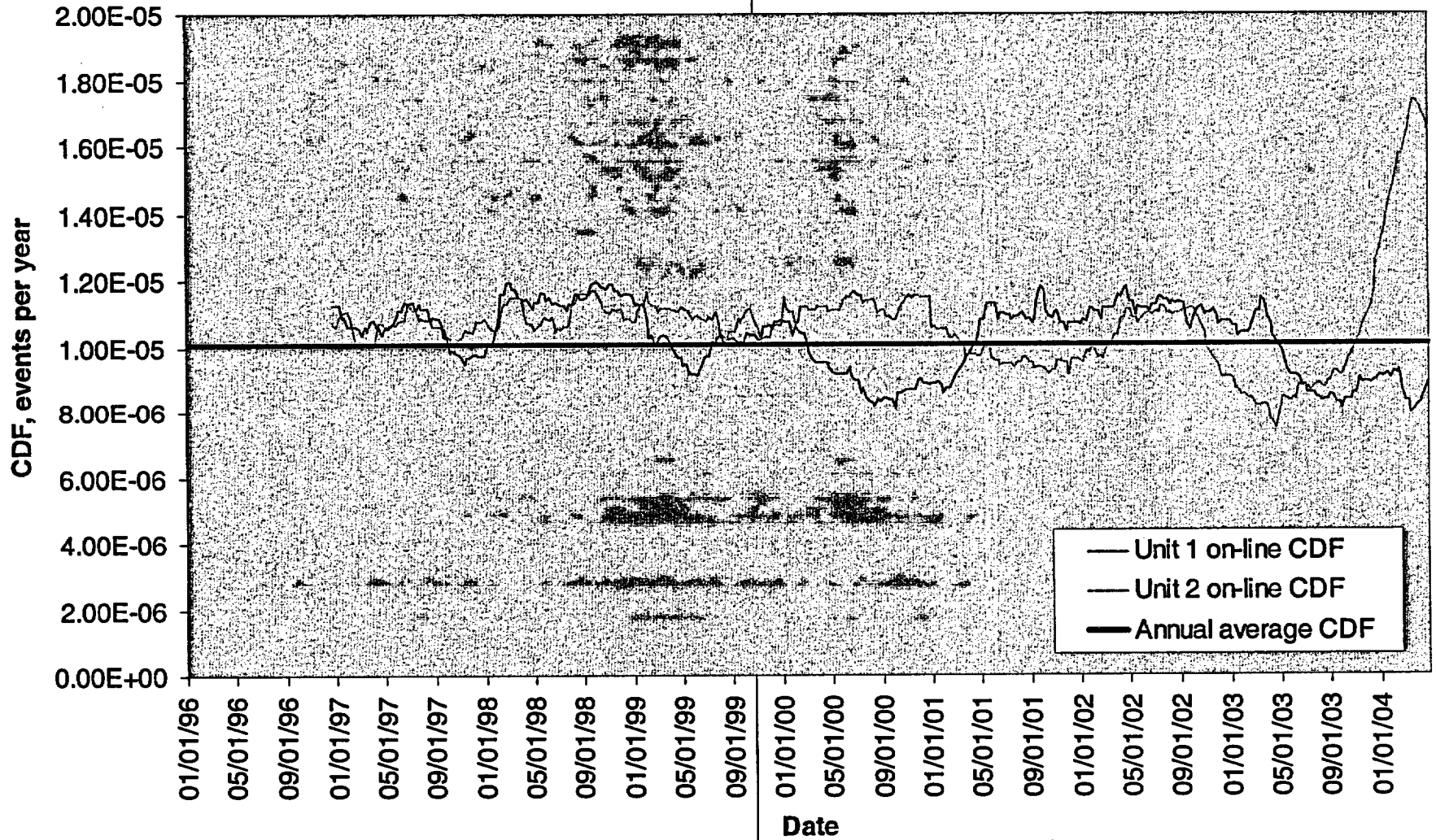


How Risk Values Add Up

Cumulative Risk Significance is the increase in the probability of a Core Damage Event due to on-line maintenance



STP Actual On-Line CDF



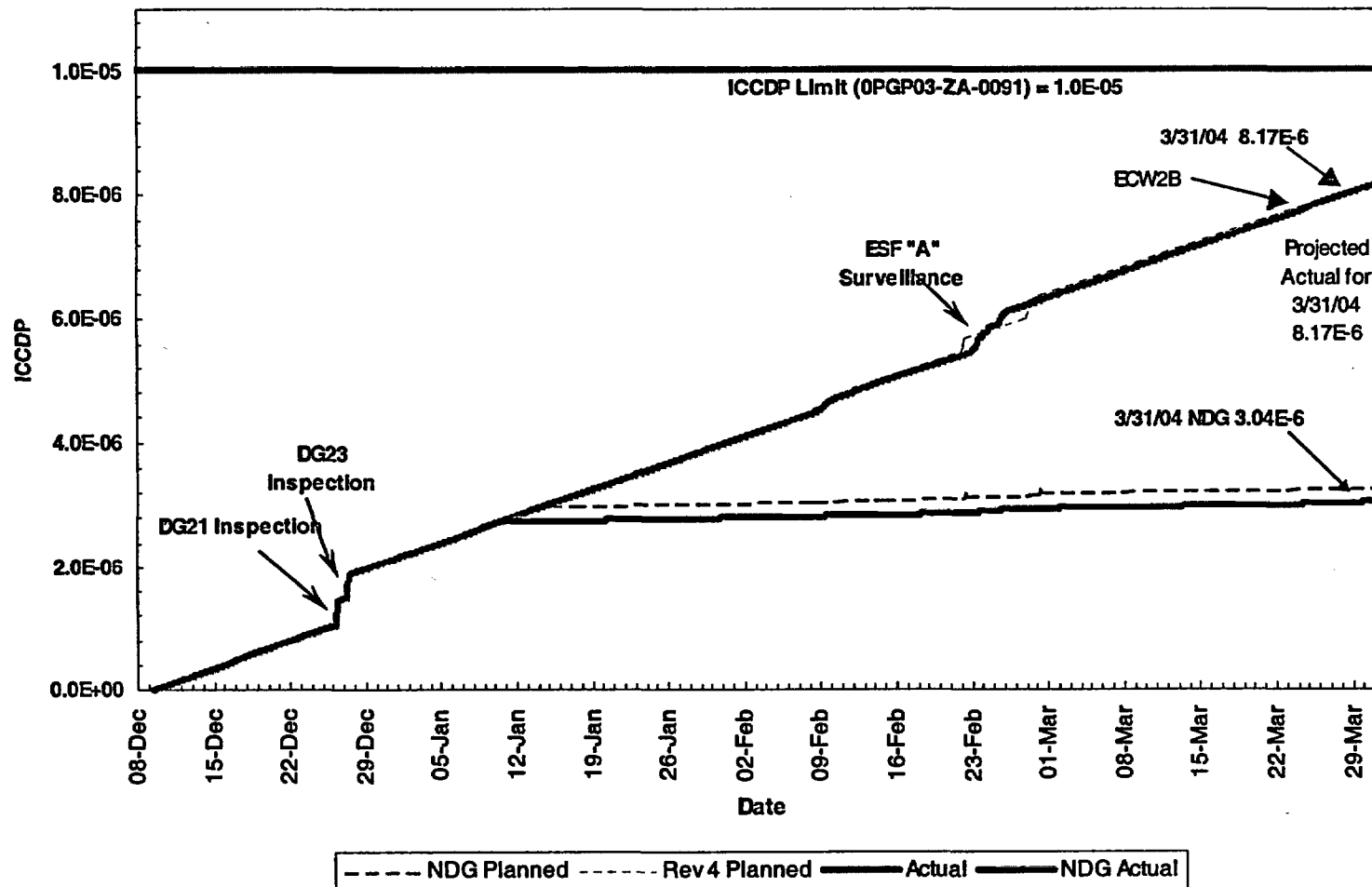
SDG 22 113 Day Extended AOT

- AOT extension met RG 1.174 and RG 1.182 acceptance criteria
- Installed non-safety DGs (NDG) as compensatory action
 - RG criteria met without credit for NDGs
- STPNOC closely monitored the risk profile
- SDG 22 successfully returned to service

SDG 22 113 Day Extended AOT

Comparison of Planned and Actual Risk (ICCDP) for Unit 2 During SDG 22 Outage

Data source: NDG Planned - PRA Rev 4 Model including NDG effect on risk (NDG failure and associated operator data are assumed)
 Rev 4 Planned - PRA Rev 4 Model assuming no NDG effect on risk
 Actuals - RAsCAL data for previous work week and PRA Rev 4



05/05/2004

**RG 1.200 (and SRP 19.1)
“An Approach for Determining the
Technical Adequacy of PRA
Results for Risk-Informed
Activities”**

Trial Implementation Phase

ACRS Informational Briefing

May 6, 2004

PURPOSE OF BRIEFING

**Inform ACRS of Current Activities and Plans
Related to Trial Implementation of RG 1.200
and Associated SRP 19.1**

AGENDA

- Background
- Objectives of RG 1.200
- Purpose of Pilots
- Scope of Pilot Applications & Staff Review
- Schedules
- Conclusions

page 3

BACKGROUND

- ASME Published ASME RA-S-2002 "Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications"
- Most Utility PRAs Peer Reviewed Following NEI 00-02, "PRA Peer Review Process Guidance"
- NEI Provided "Self-Assessment Process" to Address Differences Between ASME Standard and NEI 00-02
- DG-1122 Published for Public Review and Comment
- SONGS Peer Reviewed Using ASME Standard
- Consensus that Staff Should Publish the RG 1.200 "For Trial Use" and Test the Guide via Pilot Applications

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OBJECTIVES OF RG 1.200

- Provide Staff with Confidence that Base PRA is Adequate for the Decisionmaking Required by the Application
- Endorse Consensus Standards (e.g., ASME) as Basis for PRA Technical Adequacy
- Improve Focus and Consistency of Staff Reviews
- Reduce the Depth of the Staff Review
- Increase Public Confidence in the Adequacy of the Base PRA & the Staff Reviews

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CURRENT STAFF REVIEWS

- Subjective in Scope and Level of Detail
 - ▶ Relies on Knowledge/Experience of the Staff
- Staff Relies on Previous Reviews
 - ▶ IPE/IPEEE and Associated RES Evaluations
 - ▶ Peer Review Findings
 - ▶ Licensee PRA Quality Programs
 - ▶ Prior Risk-Informed Application Reviews
- Little Guidance on What to Submit to Address PRA Technical Adequacy

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PURPOSE OF PILOTS

- Provide Assistance in Clarifying Aspects of RG 1.200 & SRP 19.1; for example,
 - ▶ Interpretation of Documentation Needs
 - ▶ Interpretation of Requirements
 - ▶ Interpretation on Staff Positions
- Assess Licensees' Self-Assessment Approaches, Findings, & Resolution to Ensure Base PRA Properly Evaluated
- Provide Guidance on Scope and Level of Detail of Licensee Application-Specific Submittals & Staff Review
- Identify Specific Improvements to RG 1.200, SRP 19.1, ASME Standard, & NEI Self-Assessment Guidance
- Gain Insights in Resource Levels Needed for Quality Submittals & Staff Review
- Insights that Could Help Development of Other Standards

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SCOPE OF PILOTS

- 5 Applications Identified as Pilots
 - ▶ **Columbia TS - EDG Allowed Completion Time Extension**
 - Allows Extension of Allowed Completion Time to 14 Days if Identified Risk Management Actions are Established
 - ▶ **Limerick TS - 5B Initiative**
 - Surveillance Test Intervals Placed in Licensee-Controlled Document
 - Surveillance Requirements Retained in TS
 - Surveillance Test Intervals Based on Risk-Informed Process
 - ▶ **SONGS TS - Battery Replacement/DC System Reconfiguration**
 - Allow On-line Cross-tie of DC Subsystems within a Train for up to 30 Days for Maintenance or Replacement of Batteries
 - ▶ **Surry 10 CFR 50.69 Application**
 - ▶ **STP TS - 4B Initiative**

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STAFF PILOT REVIEW SCOPE

- Pilots Involve Actual Plant-Specific Risk-Informed License Applications
 - Requires Finding of PRA Technical Adequacy to Support the Staff Development of the Safety Evaluation for the Application
- Pilots will Address the Full-power, Internal Events (Excluding Internal Fires) Level 1 PRA & LERF
 - Other Aspects, such as External Events, Internal Fires, & Shutdown Operations, will be Reviewed by the Staff Consistent with Current Practices
 - When Future Standards are Developed & Endorsed (in RG 1.200) for External Events, Internal Fires, & Shutdown Operations, these Standards may also be Piloted
- Pilots will Involve More Detailed Reviews than Typical Applications to Properly "Exercise" Various Aspects of the Guidance to Gain Insights

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SCHEDULING CONSIDERATIONS

- Regular Meetings
 - Held General & Individual Applicant Public Meetings
 - Will Hold Public Meetings Throughout Trial Implementation Phase
- Pilots will Involve Multiple Licensees, Multiple Types of Applications, and Multiple Staff Reviewers
 - Efficiencies Needed to Ensure Other Licensee and Staff Activities are Not Adversely Affected During Pilot Application Phase
- As Much As Possible, the Trial Application Reviews will Overlap
 - Efficiencies Gained in Staff Resources, Lessons Learned, and in Regular Scheduled Public Meetings to Status Activities

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NEAR-TERM PILOT SCHEDULE

- Mid-May Trial application submitted for Columbia
- End of May Trial applications submitted for San Onofre & Limerick
- Week of June 7 Columbia site visit/audit
- End of June Trial application submitted for Surry
- End of June Status meeting on submittal & site visit observations
- Week of July 12 Limerick site visit/audit
- Week of Aug. 9 San Onofre site visit/audit
- End of August Trial application submitted for South Texas
- End of August Status meeting on submittal & site visit observations
- End of August RG 1.200 Appendix C Issued for Public Comment

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RG 1.200 SCHEDULE

- ACRS Subcommittee November 2004 ?
- Update RG 1.200 December 2004
- Public Meetings December 2004
- Issue for Public Comment January 2005
- Public Meeting February 2005
- CRGR/ACRS Briefing March 2005
- Issue RG 1.200 Rev. 0 April 2005

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CONCLUSIONS

- The Staff and Industry are Embarking on the Trial Implementation Phase of RG 1.200 and SRP 19.1
- This Trial Phase Involves Actual Licensee Risk-Informed Applications
- Lessons Learned During the Trial Phase will be Fed Back into Revising RG 1.200 and SRP 19.1
- Provides Insights for Phasing in Implementation of Future PRA Technical Adequacy Standards (e.g., External Events, Internal Fires, & Shutdown)

GOOD PRACTICES FOR IMPLEMENTING HUMAN RELIABILITY ANALYSIS

Presentation to ACRS – Full Committee

May 6, 2004



Erasmia Lois, NRC

John Forester, SNL

Alan Kolaczkowski, SAIC

Briefing Overview & Objective

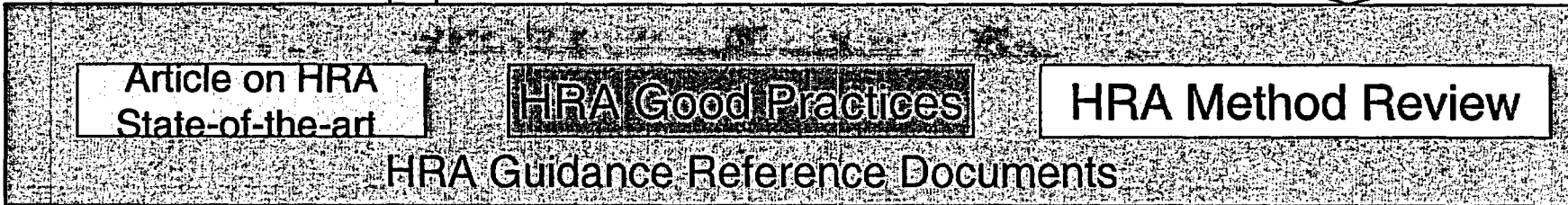
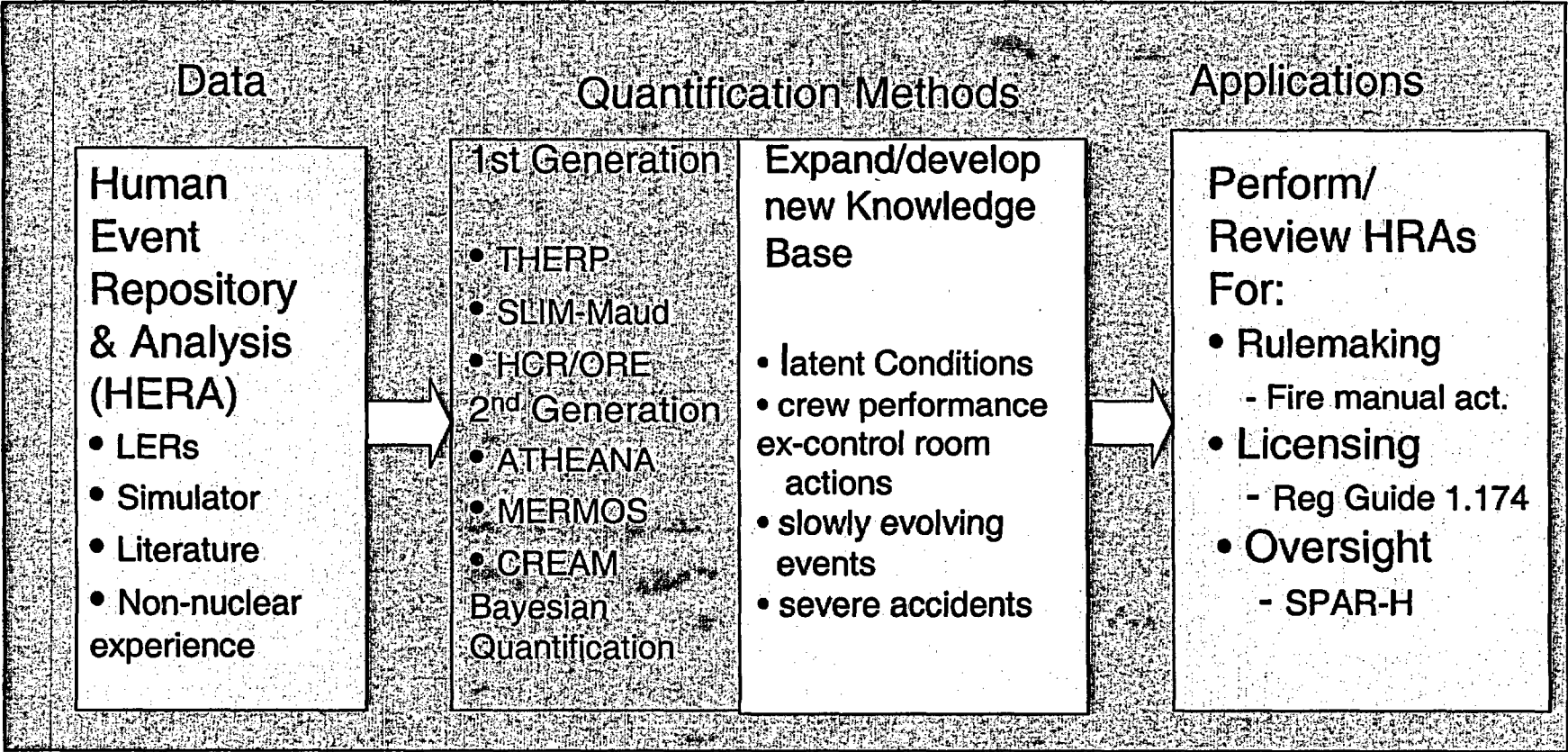
- Provide a Broad Perspective of the Human Reliability Analysis (HRA) Research Program
- Discuss in Detail the HRA Good Practices
- Request ACRS Agreement/Letter to Release the HRA Good Practices for Public Review and Comment

HRA Research Program

Issues Addressed

- HRA implementation
- Data development
- Expansion/development of new knowledge-base to address emerging NRC needs
- Specific regulatory issues

HRA Research Program Activities



HRA Guidance

3- step Approach

- Document 1: High level summary of the HRA state-of-the-art
 - Final Dec 04
- Document 2: “HRA Good Practices,” provides technical guidance for performing/reviewing
 - Public Review: July 04
 - Final Dec 04
- Document 3: Evaluation of 1st and 2nd generation HRA methods w/r to good practices
 - Draft Sept 05
 - Public Review and Comment: June 06
 - Final: Dec 06

HRA Good Practices

Issue

- PRA/HRA being used
- HRA quality is important
 - HRAs need to sufficiently represent the anticipated operator performance
 - “Modeling of human performance needs to be appropriate” NRC SRP 19
- Reg. Guide 1.200 reflects ASME RA-S-2002 and NEI 00-02
 - These address “what to do” but less on “how to do it”

Solution

- Develop HRA good practices
 - Useful to HRA non-experts as well as practitioners
- A “Good Practices for HRA” document is being created
 - Working level (how to do)
 - Will produce desired HRA
 - Draft for public comment, July 2004
 - Final, December 2004

Bases and Approach for HRA Good Practices

- Bases for HRA Good Practices
 - ASME Standard/NEI PRA Review Guidance
 - Existing HRA methods and tools
 - Insights from literature
 - PRA/HRA applications
 - Experiences of authors & reviewers of the document
- Approach for development of HRA Good Practices
 - Consensus of experts at NRC
 - Internal NRC reviews
 - ACRS feedback
 - Public comment
 - International HRA input

Scope of the HRA Good Practices

- Specifically for reactor, full power, internal events; but should be useful for external events, and to some extent other modes and non-reactor applications
- Does not endorse a specific method/tool
- Linked to the ASME Standard
- Provides possible impacts of not performing good practices and additional remarks
- Focused on HRA process (not, for example, data)

Organization of HRA Good Practices

Organized by Logical Analysis Activities

- Overall/general
- Pre-Initiators
 - Identification
 - Screening
 - Modeling
 - Quantification
- Post-Initiators
 - Identification
 - Modeling
 - Quantification
 - Add recovery actions
- Errors of Commission (EOCs)
- Documentation

Overall/General Good Practices

1. HRA is a multi-disciplined, integrated effort within the PRA
2. Some combination of talk-throughs, walkdowns, field observations, and simulations is used as appropriate, to confirm judgments and assumptions
3. HRA addresses both core damage and large early releases

Pre-Initiator Human Event Good Practices

Identify Pre-Initiators

- GPs address
 - What to review
 - What to primarily include
 - Single or “common mode” actions affecting redundant or multiple diverse equipment

Screen Pre-Initiators

- GPs address
 - How to focus the analyses on the most important contributors
- Main points
 - Do not screen (i.e., eliminate from the analysis) failures that simultaneously affect multiple (redundant or diverse) equipment
 - Revisit the original PRA screening for applications

Model Pre-Initiators

- Covered by 1 GP that addresses:
 - How and where to include pre-initiator events in the PRA model
 - when it is acceptable to combine multiple individual acts in a single event

Quantify Pre-Initiators

- Main points from 8 GPs
 - Detailed analysis for events that were not eliminated during the screening process
 - Revisit the screening process when the PRA/HRA results are to be used for specific applications
 - Consideration of performance-shaping factors
 - Treatment of dependencies
 - Criteria for reasonable human error probabilities (i.e., make sense)

Post-Initiator Human Event Good Practices

Identify Post-Initiators

- Covered by 3 GPs that address
 - What to review
 - How to review
 - Examples of general types of actions expected to be included

Model Post-Initiators

- GPs address
 - How to model & at what level (i.e., function, system, train, component level)
 - Modeling should be based on plant & accident sequence specific characteristics
 - Sequence timing
 - Cues
 - Procedures & training
 - Location of the act
 - Insights from talk-throughs, walkdowns, & simulations

Quantify Post-Initiators

- GPs address:
 - Modeling both cognitive and execution failures
 - Quantitative screening
 - Detailed analysis of the remaining events
 - Revisit estimations for specific applications
 - Use of performance-shaping factors
 - Treatment of Dependencies
 - Mean values & uncertainties
 - Check the reasonableness of resulted estimates (i.e., make sense)

Errors of Commission (EOCs)

- Encourages EOC searches
- Ensure that future plant changes do not introduce conditions prone to EOCs
- These conditions include:
 - When information to the operator could lead to a higher potential for misdiagnosis
 - When procedures and/or training could lead to a greater chance of implementation errors

HRA Documentation

- Summary of approach, disciplines involved, and extent that talk-throughs, walkdowns, simulations were used
- Summaries of methods, processes, tools to:
- Assumptions, judgments & their bases including impacts on results/conclusions
- More detail on important HFEs (e.g., PSFs, specific dependencies...)
- Sources of data and their bases for quantification (including uncertainties)
- Results (listing of important HFEs/HEPs) and conclusions

Usefulness of HRA Good Practices

- Analysts performing HRA and particularly for plant change submittals
- Reviewers reviewing HRA and when examining plant changes for acceptability