Official Transcript of Proceedings ACRST-3245

NUCLEAR REGULATORY COMMISSION

ORIGINAL

Title: Advisory Committee on Reactor Safeguards
504th Meeting

PROCESS USING ADAMS
TEMPLATE: ACRS/ACNW-005

Docket Number: (not applicable)

Location: Rockville, Maryland

Date: Thursday, July 10, 2003

Work Order No.: NRC-997 Pages 1-328

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1 UNITED STATES OF AMERICA

2 NUCLEAR REGULATORY COMMISSION

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4 ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

5 504th MEETING

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7 THURSDAY, JULY 10, 2003

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9 ROCKVILLE, MARYLAND

10 The ACRS met at the Nuclear Regulatory

11 Commission, Two White Flint North, Room T2B3, 11545

12 Rockville Pike, at 8:30 a.m., Mario V. Bonaca,

13 Chairman, presiding.

14 COMMITTEE MEMBERS:

15 MARIO V. BONACA, Chairman

16 GRAHAM B. WALLIS, Vice Chairman

17 STEPHEN L. ROSEN, Member-At-Large

18 GEORGE E. APOSTOLAKIS, Member

19 F. PETER FORD, Member

20 THOMAS S. KRESS, Member

21 GRAHAM M. LEITCH, Member

22 DANA A. POWERS, Member

23 VICTOR H. RANSOM, Member

24 WILLIAM J. SHACK, Member

25 JOHN D. SIEBER, Member

1 ACRS STAFF PRESENT:

2 JOHN T. LARKINS, Executive Director -

3 ACRS/ACNW, Designated Federal Official

4 SHER BAHADUR, Associate Director - ACRS/ACNW

5 HOWARD J. LARSON, Special Assistant ACRS/ACNW

6 SAM DURAISWAMY, Technical Assistant ACRS/ACNW

7 MIKE SNODDERLY, Senior Staff Engineer

8 MAGGALEAN W. WESTON, Staff Engineer

9 RALPH CARUSO, ACRS Staff

10 NRC STAFF PRESENT:

11 FRED BURROWS, NMSS/FCSS/FM

12 SMANTHA CRANE, RES/DET

13 AMY CUBBAGE, NRR/DRIP/NRL

14 KATHY HARVEY GIBSON, NNSS/FCSS/SPIB

15 FRANK GILLESPIE

16 HERMAN GRAVES, III

17 JAMES HAN, RES/DSARE/SMSAB

18 MARY K. HILEMAN, RES/DSARE

19 BAKR IBRAHIM, NMSS/DCOM

20 T.C. JOHNSON, NMSS/FCSS

21 PHILIP JUSTUS, NMSS/WM/HLWB

22 GARY KAPLAN

23 JOEL KLEIN

24 JOEL KRAMER NMSS/FCSS/SPIB

25 RALPH LANDRY, NRR/DSSA/SRXB

1 NRC STAFF PRESENT: (cont.)

2 STEVE LaVIE, NRR/DSSA/SPSB

3 ALAN LEVIN, RES/DD

4 STRANLAI LU, NRR/DSSA/SXRB

5 GARY MIZU, NRI-OGC

6 JAMES E. MORRIS, NMSS/INMS/RGB

7 ALEXANDER MURRAY, NMSS/FCSS/SPIB

8 ANDREW PERSINKO, NMSS/FCSS/SPIB

9 MUHAMMAD M. RAZZAQUE, NRR/DSSA/SRXB

10 BRIAN RICHTER, NRR/DRIP/RPRP

11 BRIAN SMITH, NMSS/FCSS/SPIB

12 WILKINS SMITH, NMSS/FCSS/SPIB

13 JOHN STAMATAKOS

14 JOSEPH STAUDENMEIER, RES/DSARE/SMSAB

15 BRIAN THOMAS, NRR/DRIP/FRAS

16 GEORGE THOMAS, NRR/DSSA/SRXB

17 ALI TABATABAI, ACRS (LINK)

18 EDWARD D. THROM, NRR/DSSA/SPSB

19 SPYROS TRAIFORDS, ACRS (LINK)

20 CHRISTOPHER S. TRIPP, NMSS/FCSS/SPIB

21 BILL TROSKOSKI, NMSS/FCSS/SPIB

22 REX WESCOTT, NMSS/FCSS/SPIB

23 ALSO PRESENT:

24 LEE ABRAMSON, RES/DRAA/PRAB

25 DAVID ALBERSTEIN, DOE

1 BENNETT BEACY, RES/DRAA/PRAB
2 ED BRABAZON, DCS
3 ARTHUR BUSLIK, RES/DRAA/PRAB
4 NANCY CHAPMAN, SERCH Bechtel
5 BOB FOSTER, DCS
6 ROBERT GAMBLE, GE
7 TEKIA V. GOVAN
8 HOSSEIN HAMSEHEE, RES/DRAA
9 LANE HAY, SERCH Bechtel
10 JAMIE JOHNSON, DOE
11 MARK KLOSKY, DCS
12 JUNICHI KURAKAMI, Japan Nuclear Fuel Cycle
13 Development Institution
14 EILEEN McKENNA, NRR/DRIP/RPRP
15 PAIGE NEGRES, GE
16 SCOTT NEWBERY, RES/DRAA
17 ALEX POLENSKY, Morgon, Lewis & Bockics, LLP
18 ATAMBIR RAO, GE
19 TOM ST. LOUIS, DCS
20 SAM THOMAS, DOE/WNSA
21 TOMMY TOUCHSTONE, DCS
22 ROBERT L. TREGONING, RES/DET
23 GEIT VORA, RES/DET/MEB
24 DAVID WEROER, MPR Associates/DOE
25 STEPHEN ZAH, DOE

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

2 (8:31 a.m.)

3 CHAIRMAN BONACA: Good morning. The

4 meeting will now come to order.

5 This is the second day of the 504th

6 meeting of the Advisory Committee on Reactor

7 Safeguards. During today's meeting the Committee will

8 consider the following: Mixed Oxide Fuel Fabrication

9 Facility, ESBWR pre-application review, proposed

10 criteria for the treatment of individual requirements

11 of regulatory analysis, expert solicitations report

12 for risk-informed events, Part 50.46, and proposed

13 ACRS reports. A portion of this meeting will be

14 closed to discuss the proposed ACRS Report on

15 Safeguards and Security.

16 This is meeting is being conducted in

17 accordance with the provisions of the Federal Advisory

18 Committee Act.

19 Dr. John Larkins is the Designated Federal

20 Official for the initial portion of the meeting.

21 We have received no written comments or

22 requests for time to make oral statements from members

23 of the public regarding today's sessions.

24 A transcript of portions of this meeting

25 is being kept, and it is requested that the speakers

1 use one of the microphones, identify themselves, and
2 speak with sufficient clarity and volume so that they
3 can be readily heard.
4 I would like to announce a change in the
5 agenda. The agenda item regarding the ESBWR pre-
6 application review, which was scheduled to be held
7 between 8:35 and 10:30 a.m., is now scheduled between
8 12:45 and 2:45 p.m. The agenda item regarding Mixed
9 Oxide Fuel Fabrication Facility is now scheduled to be
10 held between 8:35 a.m. and 10:30 a.m.
11 Before we proceed with the meeting, I
12 would like to begin with some items of current
13 interest. First of all, we have a number of people to
14 welcome on board.
15 We have a summer intern, Gilena Monroe,
16 who will be with us for the summer period.
17 Unfortunately, she's coming today and then she is
18 leaving before the ACRS meets again. So it's going to
19 be a short --
20 (Laughter.)
21 We're glad to see you here. Welcome
22 onboard.
23 We have two Senior Staff Engineers joining
24 us. One is Dr. Bhagwat B. Jain. Good morning. He
25 will join us as well, effective July 15th. He is

1 going to be part of the staff.

2 The other person is Marvin Sykes. He also

3 is going to be a Senior Staff Engineer with us.

4 Welcome on board.

5 Another issue I would like to bring your

6 attention to is items of interest. There are quite a

7 few items of interest there.

8 First of all, you will find NRC

9 announcements, quite a bit of organization and

10 management changes that may be of interest to you.

11 We have a couple of staff requirement

12 memoranda you want to look at, a number of speeches,

13 operating plant issues, and an interesting letter and

14 the congressional correspondence where Chairman Diaz

15 has been required to evaluate the potential

16 efficiencies that would be gained by consolidating or

17 eliminating the Regional Offices, dated June 26th,

18 2003. You may find that of interest.

19 With that, I will move to the first item

20 on the agenda, which is the Mixed Oxide Fuel

21 Fabrication Facility, and Dr. Powers will lead us

22 through this presentation.

23 MEMBER POWERS: I will. I will try.

24 CHAIRMAN BONACA: He will try.

25 MEMBER POWERS: Members should turn to

1 Item 4 in their notebook, and you'll see that we have
2 on the agenda about two hours to cover a variety of
3 topics.
4 Last month we gave you a thumbnail sketch
5 of all that's been going on in connection with this
6 Mixed Oxide Fuel Fabrication Facility, highlighted
7 some of the issues and findings from the Subcommittee
8 meetings, and today we're going to take some of the
9 central features of those items and go into them in
10 some depth.
11 Right now the staff is proceeding along on
12 a plan to issue a Safety Evaluation Report in
13 September. They have some few open items that we will
14 discuss. I believe the plan is to issue an SER in
15 September, regardless of the resolution of those open
16 items, though, quite frankly, I'm very optimistic that
17 we will close those.
18 I propose deferring any letter from this
19 Committee on the SER or the application until
20 September, unless we identify some fault in the
21 current ongoing activities that we think need to be
22 commented on in the interim. Quite frankly, I don't
23 think there's anything of that type.
24 We have a jam-packed two hours here of a
25 lot of stuff, much of which you're going to have, at

1 best, a passing familiarity with, whether you've
2 derived it from previous presentations or your own
3 reading on this. We're going to go fairly quickly
4 through this material. I'm going to be rigid in
5 enforcing time schedules. So I urge speakers to move
6 to the salient points with some confidence that,
7 despite their advancing ages, most of the members can,
8 in fact, read the viewgraphs and the associated
9 material.
10 With that, I will ask Drew Persinko if he
11 can start us off on this issue and outline what we're
12 going to be hearing here.
13 CHAIRMAN BONACA: Go ahead, Drew.
14 MR. PERSINKO: Good morning. My name Drew
15 Persinko, and I am the MOX Project Manager in the
16 Office of Nuclear Material Safety and Safeguards.
17 First, I would like to thank the Committee
18 for accommodating the rescheduling of this session,
19 due to some unforeseen events that have occurred.
20 I'm going to give some brief introductory
21 remarks before we get into the real meat of the
22 presentation, the real hard-core technical issues, but
23 I think it's important to get kind of an overview of
24 the MOX facility.
25 Depicted in this slide is both the

1 geographical and jurisdictional boundaries for the MOX
2 facility as well as the Pit Disassembly and Conversion
3 Facility. As you can see, it's depicted that weapons-
4 grade plutonium will arrive at the Pit Disassembly
5 Conversion Facility, which is under the jurisdiction
6 of the Department of Energy. The material, the
7 powered plutonium oxide, that comes out of the PDCF is
8 planned to arrive at the MOX Fuel Fabrication
9 Facility, which is where the NRC becomes involved in
10 the project.
11 The NRC is responsible for licensing the
12 Mixed Oxide Fuel Fabrication Facility, and it's also
13 responsible for the reactor side of the project, too,
14 which involves processing, reviewing the MOX fuel into
15 the reactors. Currently, the Catawba and McGuire
16 Reactors are the two reactors that are planned for the
17 project.
18 As you can see on the facility, the MOX
19 Fuel Fabrication Facility is in fairly close proximity
20 to the PDCF. Both are located on the Savannah River
21 site.
22 MEMBER WALLIS: I think there's also a
23 recycling of waste back to the DOE?
24 MR. PERSINKO: Correct. The waste from
25 the facility is temporarily stored at the Fuel Fab

1 Facility, and then it's transferred back to DOE on the
2 Savannah River site for processing. This is just to
3 give you the high-level picture of location and
4 geographical boundaries.
5 What's not shown on here, though, is also
6 about a year ago there was a change in the project.
7 Some of the material will be coming to the MOX
8 facility that was previously destined to be
9 immobilized. So it will be coming to the MOX Fuel
10 Fabrication Facility and not going through the PDCF.
11 That's not shown on this slide, though.
12 We just want to depict a high-level view
13 of the process. The first three boxes on the top are
14 the aqueous polishing part of the process, the wet
15 side of the process. It's the purpose of this is to
16 further purify the plutonium dioxide that's received
17 at the facility.
18 This is similar to the process that is
19 used at the La Hague plant in France. It involves
20 dissolving the plutonium oxide in a nitric acid using
21 silver as a catalyst. The petroleum nitrate is then
22 purified, removing impurities such as americium and
23 gallium and uranium. It's using a solvent-extraction
24 process in post columns. It also involves recovering
25 the solvent -- extracting the Pu or generating the

1 solvent and recycling the nitric acid.

2 Then there is the conversion part of it

3 where the material is converted back to a plutonium

4 oxide through oxicalcination and precipitation. At

5 this point the plutonium powder is blended with

6 depleted uranium oxide, and the bottom part of this

7 slide is the dry side of the process, which is similar

8 to the Melox, the process that's used at the Melox

9 facility in southern France.

10 It involves blending the plutonium oxide

11 with the depleted uranium oxide in two-step blending,

12 and it is much the same as a fuel fab facility. It is

13 pressed into pellets. Pellets are inserted into rods,

14 and the rods are made into assemblies, and then that's

15 transported to the reactors.

16 The licensing --

17 MEMBER LEITCH: There's a statement made

18 in some of our reading that says, "The alternate

19 feedstock, the diversity of impurities and the level

20 of impurities is higher." Is there any precedent for

21 processing this kind of material? In other words, do

22 they do something like that in France or --

23 MR. PERSINKO: No.

24 MEMBER LEITCH: -- is this a unique

25 situation?

1 MR. PERSINKO: I don't know about the DOE.
2 They may be doing it at the DOE, but in France they
3 reprocess the spent fuel, and they're not dealing with
4 weapons-grade plutonium. They're dealing with spent
5 fuel, and it's a different mixture in France than
6 what's here.
7 MEMBER POWERS: I would inject that the
8 basic chemical process can be used to purify stuff
9 that's real, honest-to-God garbage. I mean it's a
10 robust recovery processing technology that's been
11 developed.
12 MEMBER LEITCH: So we ought not be
13 particularly concerned, then, about the level of
14 impurities or the diverse nature of those impurities?
15 MR. PERSINKO: Well, we have looked at it
16 as part of our chemical review, except you'll see the
17 open items you have later, but they're not directed
18 specifically at the alternate feedstock. It's just
19 some concerns we have with the process that's
20 regardless of alternate feedstock.
21 MEMBER POWERS: I think it's safe to say
22 that it complicates the operation of the facility,
23 which may be more of a concern in the second stage of
24 the process. It's also safe to reiterate Peter's
25 concern about the issues of material corrosion in the

1 system that gets exacerbated by any time you have a
2 diversity of chemicals in the system.
3 MEMBER LEITCH: Okay.
4 MEMBER POWERS: So I wouldn't ignore it.
5 MR. PERSINKO: The licensing of the
6 facility is being performed under -- although there's
7 several regulations that do apply, the primary
8 regulation that applies is the 10 CFR Part 70,
9 Domestic Licensing of Special Nuclear Material.
10 For plutonium facilities, a two-step
11 process is permitted, and that is what we are doing.
12 There is an approval, a construction authorization
13 approval, a construction authorization, and then
14 there's a second review, which is the operation and
15 the possession of special nuclear material.
16 We are currently only at the construction
17 step right now. That's all we're talking about right
18 now.
19 Part 70 requires for the start of
20 construction of a plutonium facility that the NRC
21 approves the design bases of the principal structure,
22 systems, and complements. I emphasize design bases
23 because that's all we're really -- that is what we are
24 required to review and that is what we have been
25 reviewing.

1 So, assuming a favorable decision for
2 construction, the operating license application will
3 be at a lower level of detail than what we are
4 currently reviewing because the regulations only
5 require design basis at this point.
6 It also requires a quality assurance
7 program be approved. I would like to point out that
8 the regulation in Part 70 does require that for a
9 plutonium facility that the quality assurance program
10 be an Appendix B program, similar to or the same as
11 reactors.
12 We have reviewed and approved the QA
13 program for the facility already, and it requires that
14 an Environmental Impact Statement be performed. We
15 have issued a draft EIS. We received numerous
16 comments on it. We issued a draft EIS. We received
17 numerous comments on it, and we are currently in the
18 process of addressing those comments. We plan to
19 issue a final EIS in September.
20 MEMBER LEITCH: That QA plan you discussed
21 is for the operations phase? I mean, for the
22 construction phase only?
23 MR. PERSINKO: For the construction phase,
24 procurement. It's not operations, but it includes
25 more than strictly construction. Also, I believe it

1 covers procurement as well.

2 MEMBER LEITCH: But there will be another

3 QA plan for operations?

4 MR. PERSINKO: I think it will be updated.

5 It will be updated for operations.

6 MEMBER LEITCH: And I suppose one of the

7 things that concerns me is the qualification and

8 training and staffing of the plant, the facility.

9 They will all be issues that will be discussed in the

10 operating phase?

11 MR. PERSINKO: Well, they will be issues

12 in the operating phase, but I think there's also

13 issues about training now that we look at as well, to

14 make sure that it has the right training aspects of it

15 currently as well and the right qualifications.

16 In fact, it's not part of the QA -- well,

17 it's related to the QA plan, but that was one of the

18 issues in the criticality area that we looked at. But

19 the QA plan does address the 18 criteria that are in

20 the Appendix B, in QA 1, Appendix B. But it will be

21 updated for operations.

22 MEMBER LEITCH: Okay.

23 MEMBER KRESS: Does the EIS deal with

24 transportation issues?

25 MR. PERSINKO: Yes, it does.

1 I just want to point out the last bullet:
2 "Determine principal structure, systems, and
3 components versus the term 'items relied on for
4 safety.'" Sometimes we forget ourselves and we use
5 those terms interchangeably. So if we do, bear with
6 us.
7 The term "principal structure, systems,
8 and components," also referred to as PSSCs, is a term
9 that's applicable to construction. It's in the
10 regulation that applies to the construction of the
11 facility. The term "items relied on for safety,"
12 often called IRFS, is a term that will be used at the
13 license application, the operational phase, possession
14 and use phase.
15 It just has to do with the terms in the
16 regulation. The two are very similar in nature.
17 PSSCs for this project primarily have been proposed at
18 a systems level. The IRFSs are expected to be,
19 assuming a favorable authorization, the IRFSs are
20 expected to be at more of a component level.
21 MEMBER APOSTOLAKIS: So the PSSCs are what
22 we would call safety-related SSCs in reactors? Is it
23 the same thing?
24 MR. PERSINKO: It's similar, yes, I think
25 so. It's similar. We don't use the term "safety-

1 related," but I think it has a similar --

2 MEMBER APOSTOLAKIS: Yes, that's why I'm

3 asking.

4 MR. PERSINKO: Design bases, I want to

5 just emphasize once again that that's what we're

6 looking at, per the regulations. The definition we

7 have used is the definition that's in 50.2.

8 MEMBER APOSTOLAKIS: So this exists now?

9 I don't understand. You say --

10 MR. PERSINKO: What's that?

11 MEMBER APOSTOLAKIS: -- "information which

12 identifies the specific functions to be performed."

13 MR. PERSINKO: That's correct. That was

14 what's in the construction authorization request.

15 MEMBER APOSTOLAKIS: Okay.

16 MR. PERSINKO: That's what we are

17 reviewing right now.

18 The next phase: This is the heart, I

19 would say, of 10 CFR Part 70. I think you've had

20 discussions with other people from NRC about Part 70

21 and the performance requirements. It's not a risk-

22 based approach; it's a risk-informed approach, whereby

23 in the accident scenarios you have consequences on one

24 axes and likelihoods on the other.

25 This is in the revised Part 70. It

1 applies --

2 MEMBER WALLIS: This jargon about "highly

3 unlikely" means absolutely nothing to me.

4 MEMBER APOSTOLAKIS: Is there any

5 quantitative guidance as to what is unlikely?

6 MR. PERSINKO: It's not in the

7 regulations. It's in the Standard Review Plan.

8 MEMBER APOSTOLAKIS: Then there is

9 guidance?

10 MEMBER WALLIS: Do you mean modest theft

11 and things like that or something?

12 MR. PERSINKO: Correct.

13 MEMBER WALLIS: So there is a

14 quantification? What is it?

15 MR. PERSINKO: In the Standard Review

16 Plan, though, but not in the regulation.

17 MEMBER APOSTOLAKIS: So what is it? What

18 is an unlikely event?

19 MR. PERSINKO: "Highly unlikely" is on the

20 order of about 10 to the minus fifth, unlike --

21 MEMBER APOSTOLAKIS: Per year? Per year?

22 MR. PERSINKO: Per year.

23 MEMBER APOSTOLAKIS: Yes?

24 MR. PERSINKO: Per accident scenario,

25 though. It's not a cumulative risk analysis.

1 And "unlikely" is in the order of 10 to
2 the minus third to 10 to the minus fifth.
3 MEMBER WALLIS: So "not unlikely" is quite
4 likely to occur during the life of the plant or
5 something?
6 MR. PERSINKO: Yes. Yes. The applicant
7 has proposed non-quantitative definitions that it
8 intends to use for these terms, and that's in the
9 construction authorization request as well, but in the
10 Standard Review Plan there are some suggested
11 quantitative numbers.
12 MEMBER APOSTOLAKIS: The "high
13 consequences public dose" is greater than 25 rem.
14 MR. PERSINKO: Correct.
15 MEMBER APOSTOLAKIS: Now does it say
16 anywhere that this is from a particular sequence or
17 cumulative?
18 MR. PERSINKO: No, it's a particular
19 sequence.
20 MEMBER POWERS: It's sequence by sequence.
21 We have been over this many times. This is the ISA
22 approach.
23 MEMBER APOSTOLAKIS: The what?
24 MEMBER POWERS: This is the ISA approach.
25 MEMBER WALLIS: And you have workers and

1 public, and then you have people who are not workers
2 who are treated as workers.
3 MR. PERSINKO: That's correct. You have
4 workers. In this particular facility we could spend
5 a whole couple of hours on it, if you would like.
6 MEMBER WALLIS: No, we don't want you to
7 do that.
8 MR. PERSINKO: But just to let you know
9 that there is -- because this facility is an island
10 and within a DOE site, there are facility workers,
11 which are the workers that work right at the MOX
12 facility; there are site workers, which work at the
13 Savannah River site, and there are the public, which
14 are the people offsite.
15 I will just point out very quickly, and we
16 can get into it, but it's rather complicated. But
17 there are also, per the definition of a worker in Part
18 20, you could have a worker who is, our definition of
19 worker who is on the Savannah River site. It's a
20 person who does not experience a radiological -- a
21 worker is a person who does experience a radiological
22 dose in the course of his or her normal course of
23 duties.
24 So, for example, according to NRC's
25 interpretation, which is in Part 20, if you're a

1 cafeteria worker on the DOE site, you're considered a
2 member of the public for Part 20 purposes. For Part
3 70 purposes, however, there is a provision in Part 70
4 that deals specifically with the performance
5 requirements, that if you meet certain provisions,
6 certain training requirements, certain notifications
7 about the risk of the facility, that person can be
8 treated as a worker for the purposes of the
9 performance requirements.
10 MEMBER KRESS: Is there an equivalent
11 table of this for other types of consequences other
12 than radioactive, such as heavy-metal poisoning or
13 plutonium exposure, that's --
14 MR. PERSINKO: No, these are the -- well,
15 there are doses. There are also requirements in the
16 -- there's dose requirements. There's also
17 requirements in the Part 70 regulations dealing with
18 chemicals, but we have to be careful with that because
19 we have very carefully in Part 70 -- for example, we
20 don't regulate chemicals for the sake of regulating
21 chemicals. We only regulate them according to the
22 regulation which talks about licensed materials and
23 hazardous chemicals derived from licensed materials,
24 and if a chemical release can affect the safety of the
25 plant in some other way.

1 MEMBER KRESS: I see.

2 MEMBER APOSTOLAKIS: So there has been

3 analysis like this for the proposed facility? How

4 many sequences that lead to high consequence have been

5 identified?

6 MR. PERSINKO: I don't know the exact

7 number.

8 MEMBER KRESS: It's a small number,

9 though. It's like three or four.

10 MR. PERSINKO: I don't remember.

11 MEMBER KRESS: So, you know, when you add

12 up these --

13 MEMBER APOSTOLAKIS: When you add them up,

14 you don't get --

15 MEMBER KRESS: You don't get a lot. It's

16 not like --

17 MEMBER POWERS: We'll discuss that over

18 the course of the presentation. There's a specific

19 item on the estimated risk to the public.

20 MR. PERSINKO: I just want to explain also

21 that the performance requirements, when you read the

22 regulation, talk about IRFS and meeting the

23 performance requirements. So it strictly applies to

24 the operational phase, but the applicant has adopted

25 this approach in order to identify the PSSCs as well,

1 which is I think a good idea because it gives you some
2 guidance. Otherwise, there's no guidance in the
3 regulation as to what is a PSSC.
4 Okay, I would like to talk about schedule
5 a bit. We have a little history here. Also, we
6 received an Environmental Report back in 2000,
7 December of 2000. We received the construction
8 authorization request, the first one, in February of
9 '01.
10 Staff issued its first draft Safety
11 Evaluation Report for construction in April of '02, at
12 which point, slightly before we issued that SER, the
13 applicant -- there was a program redirection whereby
14 the immobilization part of the project was cancelled
15 and a large part of the material that was destined to
16 be immobilized will be going to the MOX facility. So
17 that required some upfront modifications to the policy
18 part of the process.
19 So, based on that, the Environmental
20 Report and the Construction Authorization Report were
21 revised. That's why you see there was a revised ER
22 sent in in July of '02, a revised Construction
23 Authorization Report in October of '02, to accommodate
24 the material that was formerly meant to be
25 immobilized.

1 The staff has issued a draft EIS for
2 public comment in February of this year. It was out
3 for public comment. We received the public comments.
4 The public comment period is closed and we are in the
5 process of finalizing -- of addressing those comments.
6 Staff also issued a revised draft SER for
7 construction in April of this year, which is the
8 subject of today's meeting. We also intend to issue
9 a final EIS and a final SER in September of '03. We
10 intend to issue an EIS Record of Decision and a
11 Construction Licensing Decision in October of '03.
12 That concludes my presentation.
13 MEMBER POWERS: Any questions on the
14 overview?
15 (No response.)
16 If not, I will ask Gary Kaplan to give us
17 the applicant's perspective on the general facility
18 and mission and layout and the discussion of their
19 safety philosophy, both with respect to prevention and
20 mitigation.
21 Gary, I'm dying to know: What is this,
22 Hastings doesn't like us anymore? We have offended
23 him?
24 MR. KAPLAN: I think he's in Bermuda this
25 week.

1 MEMBER POWERS: What?

2 MR. KAPLAN: I think he's in Bermuda this

3 week.

4 MEMBER POWERS: Bermuda? From now on,

5 we're going to visit him directly. If he's not going

6 to show up here, we're going to go where he is.

7 (Laughter.)

8 MR. KAPLAN: Good morning. My name is

9 Gary Kaplan. I'm the ISA lead for the MOX Project.

10 If we go to the next slide, as you know,

11 the mission of the MOX facility is to transform

12 plutonium so it's unusable.

13 If we go to the next slide, we briefly

14 talk about the facility layout. The key features on

15 this slide are the actual MOX processing area. It's

16 the largest building in the center. It's the BMP.

17 You'll find the label there.

18 The aqueous polishing building is adjacent

19 right to it, contiguous building. It's the BAP to the

20 lower left.

21 Another major feature right here is the

22 Emergency Diesel Generator Building, over here in the

23 lower right corner. Notice the stack is right over

24 here, and it's approximately 100 meters to the edge of

25 our fenceline over here, and it's approximately five

1 miles to the site boundary of the Savannah River site.
2 So those are some of the key features of the layout.
3 MEMBER POWERS: Could you point out on
4 this slide where waste is accumulated and then
5 transferred back to this thing we were seeing?
6 MR. KAPLAN: Let's see, well --
7 MEMBER POWERS: It's mainly chemical
8 waste.
9 MR. KAPLAN: Right. It's just briefly
10 stored in the -- let's see, which building here? I
11 believe in the AP Building there's a storage area, and
12 then it would be shipped by or transferred by pipe to
13 this event oversight facilities. I'm not sure which
14 direction. I believe it will be stored in the Aqueous
15 Polishing Building.
16 MEMBER POWERS: Right.
17 MR. KAPLAN: Okay, the next couple of
18 slides, we have those. You can go to the next slide.
19 I'm going to give an overview of the process of what
20 we are doing for the CAR, what we've done for the CAR,
21 and what we're doing for the license application, as
22 well as the final slide I'll talk a little bit about
23 our terminology and try to clear up some of the
24 discussion with defense in-depth.
25 The ISA that we are performing is an

1 integral part of the design process. It's an
2 iterative process with design. As the design evolves,
3 the ISA, we perform more sophisticated and detailed
4 analysis as necessary.
5 Initially, in the CAR, based on the site
6 description and the preliminary design, we identify
7 hazards and events associated with the NF design and
8 operations. We considered natural phenomena that are
9 relevant to the Savannah River site. We considered
10 external, man-made hazards from nearby facilities,
11 nearby railways or roadways or airports.
12 From that, for some of the natural
13 phenomena and the external, man-made hazards, we did
14 initial screening evaluations to determine if they
15 were credible. For instance, we screened out
16 avalanches, tsunamis, things like that, based on where
17 the site is, very low-likelihood events.
18 The one man-made hazard that we did an
19 evaluation of was aircraft crashing into the facility,
20 and delayed probability event from accidents.
21 MEMBER APOSTOLAKIS: Now the aircraft is
22 non-intentional?
23 MR. KAPLAN: Non-intentional, correct.
24 MEMBER POWERS: That's correct.
25 MEMBER WALLIS: The seismic is a little

1 problematic.

2 MR. KAPLAN: Which one?

3 MEMBER WALLIS: You've got this one event,

4 seismic --

5 MR. KAPLAN: Right.

6 MEMBER WALLIS: -- one event every 500

7 years, more or less.

8 MR. KAPLAN: And certainly we considered

9 seismic. That wasn't screened out, right.

10 Based on the potential unmitigated

11 consequences of these events, we identified a safety

12 strategy, and from that we identified the principal

13 SSCs required to either mitigate or prevent these

14 events.

15 As Drew's little matrix showed, you can

16 either attempt to mitigate the consequences or you can

17 prevent the consequences. Either way, you can satisfy

18 the criteria 10 CFR 70.61.

19 Once we identified the principal SSCs, we

20 then identified specific design-basis.

21 MEMBER POWERS: Gary, I think that comment

22 that you can either prevent or you can mitigate is a

23 little too stark. You still have a requirement of

24 defense in-depth in this facility.

25 MR. KAPLAN: That's correct, right.

1 MEMBER POWERS: So I wouldn't portray it
2 as it's one or the other.
3 MR. KAPLAN: Right.
4 MEMBER POWERS: You end up having to do
5 both.
6 MR. KAPLAN: We do both, and we'll talk
7 about that in the last slide. What we credit, in
8 principal SSCs we normally do one or the other. There
9 was the box in the middle that kind of allowed you to
10 do part of both, either reduce the likelihood somewhat
11 and reduce the consequence. The range is so small in
12 there that we didn't use that box anywhere. We either
13 made the event highly unlikely or we reduced the
14 consequences down very low.
15 MEMBER POWERS: Well, it seems to me that
16 I would not just --
17 MR. KAPLAN: Couch it that way? Right.
18 MEMBER POWERS: And I just comment or
19 harken back to your approach on Red Oil, where you're
20 saying, okay, I'm going to keep the temperatures
21 low --
22 MR. KAPLAN: Right.
23 MEMBER POWERS: -- but I'm also going to
24 clean the solvent.
25 MR. KAPLAN: Sure.

1 MEMBER POWERS: I mean, you can't rely on
2 one thing to keep everything low.
3 MR. KAPLAN: That's correct.
4 The design basis that we have described in
5 the CAR included the safety function values, where
6 appropriate, and commitments to codes and standards
7 that we're going to design the facility to.
8 One example of this would be we
9 identified, as you said, earthquake as a natural
10 phenomena hazard. In an event scenario we would come
11 up with the building could fall and disperse
12 plutonium. So we come up with a strategy: Design the
13 building to withstand the earthquake, and we describe
14 that.
15 We identify the appropriate magnitude
16 earthquake that we're going to design to, and we've
17 provided all the structural code and standards in the
18 CAR that we're designing to, as well as methodology.
19 MEMBER APOSTOLAKIS: What is that
20 earthquake? Do you know?
21 MR. KAPLAN: I think it's a .2 g
22 earthquake.
23 MEMBER APOSTOLAKIS: Point two?
24 MR. KAPLAN: Right. It's anchored with a
25 different --

1 MEMBER APOSTOLAKIS: Is it another -- oh,
2 yes, that's --
3 MR. KAPLAN: Right.
4 MEMBER KRESS: You choose that by sound
5 frequency?
6 MR. KAPLAN: That's correct.
7 MEMBER KRESS: Driven by New Madrid?
8 MR. KAPLAN: Not the seismic. Does
9 anybody in my crowd know what that is driven by?
10 MEMBER POWERS: It's driven by Charleston,
11 and there's another fault zone just north of the
12 Savannah River site. It also changes your
13 frequencies, but it's consistent with the design of
14 facilities on the Savannah River site.
15 MR. KAPLAN: Right, and there is a
16 discussion letter today on seismic --
17 MEMBER POWERS: Right.
18 MR. KAPLAN: -- that I think will cover
19 some more detail on that.
20 Okay, if you go to the next slide,
21 continuation of the process: As the design evolves,
22 we do more detailed analysis, and major steps are: We
23 identified detailed event scenarios that identify
24 specific IRFSs and also we challenged those IRFSs to
25 determine if they can withstand all the different

1 events.

2 The main type of analysis we're doing are
3 process hazards analysis. We're doing haz ops, "what
4 if's," fault tree analysis, where appropriate, to
5 challenge and identify IRFSs.

6 The next major step is we demonstrate that
7 the IRFSs are effective through supporting
8 calculations. The majority of these calculations are
9 standard design calculations. An example would be,
10 following up on the earthquake example is they're
11 doing design calculations to demonstrate that the
12 building will withstand a .2 g earthquake, and that
13 certainly supports the ISA.

14 We also do, as necessary, failure loads
15 analysis on the specific IRFSs to ensure that they can
16 withstand the challenges. A good example that we've
17 already talked a lot about is the HEPA filters. We've
18 identified HEPA filters as a major, as a principal
19 SSC, and we have done failure modes analysis to
20 determine, will soot, temperature, other factors, how
21 they can impact the HEPA filters, and then we do
22 evaluations to demonstrate that we can handle the
23 soot, the temperature, things like that.

24 The next major piece is we demonstrate the
25 event likelihood satisfies the performance criteria of

1 10 CFR 70.61. What we have committed to at this point
2 is compliance with the single-failure criterion,
3 worked out a contingency for criticality events.
4 We're going to identify means to detect
5 failures of IRFSs. We've committed to specific codes
6 and standards, and we've committed to the 10 CFR 50
7 applicable Appendix B QA program.
8 I think that covers it. That gives you a
9 high-level overview of our ISA process from the
10 beginning all the way through the license application.
11 MEMBER POWERS: I think it's important for
12 people to understand that the ISA, in summary, comes
13 in the second step for this.
14 MR. KAPLAN: That's correct. That's
15 correct.
16 MEMBER APOSTOLAKIS: The second step?
17 Which step is that?
18 MEMBER POWERS: At this point we're still
19 working with the design basis.
20 MR. KAPLAN: That's correct. The second,
21 with the license application, we will summarize all
22 these calculations that demonstrate the IRFSs can
23 perform their job.
24 MEMBER APOSTOLAKIS: Now this likelihood
25 that you estimate, is that a point value?

1 MR. KAPLAN: No, on an event-sequence
2 basis we're going to demonstrate that we meet single-
3 failure criteria.
4 MEMBER APOSTOLAKIS: But it says,
5 "likelihood."
6 MR. KAPLAN: Well, this is how we're
7 meeting the likelihood criteria.
8 MEMBER APOSTOLAKIS: I see. You don't
9 have an explicit, quantitative measure of the
10 likelihood?
11 MR. KAPLAN: That's correct. As part of
12 the license submittal, we will not have, that's
13 correct.
14 MEMBER APOSTOLAKIS: And single failure
15 includes passive failures --
16 MR. KAPLAN: Sure.
17 MEMBER APOSTOLAKIS: -- and everything?
18 MR. KAPLAN: That's correct.
19 MEMBER APOSTOLAKIS: But a system?
20 MR. KAPLAN: Well, we do have an event-
21 sequence basis. So for all these hundreds of events
22 that we've identified, we will show that we meet
23 single-failure criteria.
24 MEMBER APOSTOLAKIS: I don't understand
25 what that means, the "sequence." I mean, I can

1 understand, if you give me a system, that there would
2 be no single failure failing the system.
3 MR. KAPLAN: Right.
4 MEMBER APOSTOLAKIS: But if you give
5 sequences, you mean that there would be no sequences
6 with one event in them? Is that what you mean?
7 MR. KAPLAN: There would be no sequences
8 where we don't meet the single-failure criteria
9 applying the IRFS. It's a little different than
10 reactors because a lot of our events, you know, we
11 have distributed material at risk throughout the
12 facility as opposed to a reactor. So there's lots of
13 isolated events that don't really depend on an entire
14 system. It might depend on more isolated features.
15 MEMBER APOSTOLAKIS: That's fine, but how
16 does one apply the single-failure criterion to a
17 sequence? I mean, that's where I don't --
18 MR. KAPLAN: Well, I happen to have my
19 probability expert with us. Maybe he can help. Mark?
20 MEMBER APOSTOLAKIS: You have to come to
21 the microphone and tell us who you are.
22 MR. KLOSKY: Mark Klosky, DCS.
23 I think what we're trying to illustrate
24 here is that we identify event sequences, and in so
25 doing, identify the requisite features that we've

1 identified as at this stage principal SSCs, but later
2 to become IRFSs. What we're saying is that no single
3 failure to the system, the system being the IRFS, will
4 result in the event sequence occurring.
5 MEMBER APOSTOLAKIS: So you're going back
6 to the system then?
7 MR. KLOSKY: Yes.
8 MEMBER APOSTOLAKIS: You're not
9 applying --
10 MR. KLOSKY: The system, correct, yes.
11 MEMBER APOSTOLAKIS: Which means, though,
12 there would be no event sequence with just one event?
13 Right?
14 MR. KLOSKY: Yes.
15 MEMBER APOSTOLAKIS: Okay.
16 MR. KLOSKY: That's correct.
17 MR. KAPLAN: Okay, we'll go to the next
18 slide. This slide illustrates the defense-in-depth
19 philosophy and it attempts to clarify some of the
20 associated terminology.
21 If you assume in the middle we have the
22 hazard and/or the event, our first layer of defense
23 from these hazards and events are what we call
24 additional protection features. These reduce the
25 challenges to the IRFSs by either preventing or

1 mitigating the event before it would impact or require
2 the IRFSs to take action.
3 These are protection features normally
4 associated with normal operations such as trained
5 operators, normal operations alarms. More specific
6 ones might be the nitrogen blanket that we have in the
7 glove boxes, the hand-held fire extinguishers, things
8 that we don't credit in the safety analysis as
9 principal SSCs or IRFSs. They're certainly in the
10 facility and provide additional protection.
11 MEMBER WALLIS: This is a very
12 interesting, sort of qualitative cartoon, but what
13 really matters is the degree of total protection, and
14 the fact that you have three stages doesn't assure a
15 certain degree of protection necessarily.
16 MR. KAPLAN: That's correct. This is just
17 trying to illustrate there were some terminology
18 questions --
19 MEMBER WALLIS: It's not qualitative if
20 it's a cartoon.
21 MR. KAPLAN: Right.
22 MEMBER WALLIS: But this is some measure
23 of total protection achieved by this process?
24 MR. KAPLAN: To meet the 10 CFR 70.61
25 requirements, all we're crediting are the principal

1 SSCs or IRFSs, and that satisfies that portion. We
2 believe the rest of this satisfies the requirements of
3 10 CFR 70.64, the defense-in-depth requirements. We
4 don't have a qualitative --
5 MEMBER WALLIS: So there's no measure of
6 defense in-depth?
7 MR. KAPLAN: That's correct. We don't
8 have a quantitative target at this point, that's
9 correct.
10 MEMBER WALLIS: So there's no indication
11 that having three steps is better than two or anything
12 except as a qualitative thing?
13 MR. KAPLAN: Right, that's correct. And
14 this wouldn't really indicate that we have three.
15 There might be 10 layers in there, that's right.
16 MEMBER WALLIS: It doesn't help you to
17 decide whether to have three or four if you don't have
18 any missions.
19 MR. KAPLAN: The next layer of defense are
20 the actual principal SSCs and IRFSs. Those are the
21 features that we credit to satisfy 70.61.
22 Note that we've committed to the single-
23 failure criteria. So this is where, just in this
24 layer alone, we have redundancy and/or diversity at
25 this point, just in this one layer.

1 The next layer are what we call --

2 MEMBER POWERS: You specifically said,

3 "redundancy and/or diversity" there. Talk to me a

4 little bit about your philosophy on when you select

5 between redundancy, mere redundancy, and when you go

6 with diversity.

7 MR. KAPLAN: These facilities are based on

8 no extra line design. I believe in most cases we have

9 redundancy.

10 MEMBER POWERS: Yes, I think you're

11 basically going with a redundancy design.

12 MR. KAPLAN: That's correct. There are

13 some cases -- I'm trying to think of some specific

14 examples where there's diversity in what's used. I

15 don't have any off the top of my head. I don't

16 know --

17 MEMBER POWERS: But if we look at the

18 principal safety features that you have, for instance,

19 take emergency power, basically, a redundant system.

20 That's a highly redundant system.

21 MR. KAPLAN: That's correct.

22 MEMBER POWERS: What, four different

23 electrical power sources coming into the facility?

24 MR. KAPLAN: There's the standard power.

25 There's the standby diesels. There's the emergency

1 power, and we have batteries also, if necessary.

2 MEMBER POWERS: Yes.

3 MR. KAPLAN: Right.

4 MEMBER POWERS: And if we look at HEPA

5 filtration, basically, a redundant system.

6 MR. KAPLAN: The part that's credited is

7 basically redundant, that's correct, but there's

8 multiple players of HEPA filtration also outside of

9 that redundancy.

10 MEMBER POWERS: That also seems to be

11 another critical design feature that Drew mentioned.

12 You have adopted a zonal kind of construction to this

13 facility?

14 MR. KAPLAN: That's correct.

15 MEMBER POWERS: And so you have

16 essentially four nested zones with pressure

17 differentials between each of them?

18 MR. KAPLAN: Between, yes, the glove boxes

19 and the public, right.

20 MEMBER POWERS: So those are the essential

21 design bases that we're looking at in this stage on

22 this. It basically is a redundant system, basically,

23 a classic zonal kind of strategy?

24 MR. KAPLAN: That's correct. Well, in the

25 glove box is where the plutonium is. There's one

1 ventilation system that's surrounded by another
2 ventilation system in the room, surrounded by the
3 building ventilation system. That's correct.
4 That's one of the examples of a defense-
5 in-depth feature. Those are features that we don't
6 credit in the safety analysis, but they are IRFSs for
7 some other event, where we have decided to upgrade
8 them to IRFSs for an additional protection.
9 An example is the building ventilation
10 system. It's not credited to satisfy any of the
11 requirements of the 70.61, but we have that feature
12 there. So that provides another layer of defense.
13 MEMBER KRESS: When you identify something
14 as an IRFS, does then put the requirements on testing,
15 inspection --
16 MR. KAPLAN: Oh, sure.
17 MEMBER KRESS: -- and quality assurance?
18 MR. KAPLAN: That's correct.
19 MEMBER KRESS: And things of that nature?
20 MR. KAPLAN: We apply the whole QA program
21 to it, that's correct, as well as additional
22 management measures that we've specified.
23 Then, to finalize the terminology, all of
24 these combined would be our defense-in-depth
25 philosophy. So we've kind of used two sets of defense

1 in-depth, one for specific features as well as the
2 entire license.
3 MEMBER POWERS: Let me ask you this
4 question: We've discussed prevention and mitigation
5 features, but in the end, when you have an event, you
6 have to put the facility into a safe configuration,
7 and that's a problem because there's material in the
8 system; you can't get the material out of the system,
9 and it has to be there.
10 What is the safe configuration for your
11 facility?
12 MR. KAPLAN: The safe configuration is
13 what we've committed to in keeping the glove box
14 ventilation system basically running. That's the safe
15 configuration.
16 On the AP side, for short durations we can
17 shut the processes down and be in a stable
18 configuration.
19 MEMBER POWERS: It seems to me you move
20 the fluid to tanks in the AP system.
21 MR. KAPLAN: That's correct.
22 MEMBER POWERS: You shut the furnaces
23 down. You maintain the ventilation. That's your safe
24 configuration?
25 MR. KAPLAN: That's correct.

1 MEMBER POWERS: At that point you can
2 continue with that situation essentially indefinitely?
3 MR. KAPLAN: That's correct, for long
4 periods of time. That's right.
5 So the major system that has to keep
6 running is the ventilation system. That's similar to
7 what reactor systems would be like. It's completely
8 independent and separate.
9 MEMBER POWERS: And that's essentially
10 you're providing them complete ability?
11 MR. KAPLAN: That's right.
12 MEMBER POWERS: Yes, that's right. I
13 think it's important to understand that in the design
14 basis here.
15 MR. KAPLAN: That's right.
16 MEMBER POWERS: That there is a safe
17 configuration; there is prevention; there is
18 mitigation in this facility. Okay.
19 MR. KAPLAN: Okay.
20 MEMBER POWERS: It is only when you come
21 to the construction phase of the application that we
22 get any real estimation of the residual risk that this
23 facility poses?
24 MR. KAPLAN: Excuse me.
25 MEMBER POWERS: It is only at the end, in

1 the construction phase, that we get what this
2 Committee would recognize as the completed ISA, which
3 is some indication of the risk this facility poses to
4 the public? You get the results of the ISA?
5 MR. KAPLAN: You get the results of the
6 ISA. I mean, you have some indication now.
7 MEMBER POWERS: Oh, yes, right. Yes, we
8 have some indication, but the formal results of the
9 ISA really appear as part of the construction.
10 MR. KAPLAN: As part of the ISA, you were
11 saying?
12 MEMBER POWERS: Yes, that's right.
13 MR. KAPLAN: That's correct.
14 MEMBER POWERS: Okay, good. Thank you.
15 MR. KAPLAN: Okay, thank you.
16 MEMBER POWERS: We move now to some of the
17 major technical issues associated with this. Drew,
18 are you going to walk us through and introduce your
19 various speakers here?
20 MR. PERSINKO: Yes. Okay. For
21 criticality safety, it's going to be Christopher
22 Tripp. Following that, we will have fire safety, Rex
23 Wescott. Red-Oil discussion will be Alex Murray, and
24 then the next one will be Rex Wescott also. Seismic
25 is going to be John Stamatakos.

1 MEMBER WALLIS: Is someone taking about
2 explosions in fires and such?
3 MR. PERSINKO: Yes, fire safety, Rex
4 Wescott will talk about, and explosives we'll cover
5 also.
6 MR. TRIPP: I'm going to talk a little bit
7 about the criticality safety review for the MOX Fuel
8 Fabrication Facility. First, I'm going to go through
9 the design bases a little bit and then discuss the
10 open issue that we still have.
11 These are the 10 design bases for the
12 facility that are described in Chapter 6 of the CAR.
13 They mostly consist of programmatic design criteria
14 that we have reviewed at the CAR stage. They give us
15 confidence, hopefully, that the design, if we see a
16 design, it will be found generally acceptable.
17 We found favorable, made favorable
18 conclusions, with the exception of the second one on
19 this list that I'll discuss in some more detail in a
20 minute.
21 MEMBER WALLIS: Now the second one, I was
22 curious; we know nothing about this coming in. It
23 seems to me this magic number of .95 would seem to me
24 rather strange. I mean, what really matters is the
25 probability of getting a k-effective of one. There's

1 nothing magical about .95?

2 MR. TRIPP: Right, that's true. As long

3 as the true k-effective of the system is less than --

4 MEMBER WALLIS: Point nine-five plus or

5 minus a sigma of, you know, .05 or something is

6 probably unacceptable.

7 MEMBER POWERS: I'll remind you that we're

8 working on design bases here.

9 MEMBER WALLIS: Oh, this is a "funny

10 world" word?

11 MEMBER POWERS: No, no, we're working on

12 design bases.

13 MEMBER WALLIS: Well, okay, we're in the

14 regulatory world then.

15 MEMBER POWERS: We're working on design

16 bases, which you use as the basis for your design.

17 MEMBER WALLIS: Yes. Well, why is this

18 the basis? The real basis should be, what's the

19 probability of getting a k-effective that's

20 unacceptable?

21 MR. TRIPP: Well, yes, and I think what we

22 have used was a setting a conservative margin that

23 gives us some confidence that we don't exceed a

24 k-effective of one in the real world.

25 MEMBER WALLIS: If it is really

1 conservative, yes, and maybe you'll get into that.

2 MR. TRIPP: Yes.

3 MEMBER WALLIS: So coming in and not

4 knowing the history of this kind of stuff, it seemed

5 to me strange you just focused on the maximum

6 k-effective, because it isn't by itself a hazard of

7 any kind.

8 MR. TRIPP: Right.

9 MEMBER WALLIS: It isn't a reassurance of

10 any kind really, either.

11 MR. TRIPP: Well, what we're doing is

12 we're setting some limit in k-effective that gives us

13 assurance that's it's sub-critical really. The only

14 distinction we really need to make is between sub-

15 critical and --

16 MEMBER WALLIS: Well, you're going to talk

17 about an uncertainty in that then, yes. Okay, we'll

18 go ahead, please.

19 MR. TRIPP: Yes, that includes the

20 uncertainty.

21 I'm not going to belabor each of these.

22 Several of these come out of the regulations. The

23 first one comes from the baseline design criteria in

24 70.64.

25 The second one is really a design basis;

1 we consider it a design basis because this has to be
2 known prior to doing the design calculations to set
3 the sub-critical limits. You need to know what the
4 acceptance criterion is before you can complete the
5 design.
6 The third comes from 70.61(d), and it
7 deals with a margin of sub-criticality and requirement
8 to identify the abnormal conditions in the facility.
9 Criticality accident alarm systems are required by
10 70.24(a), unless specific exemption is requested and
11 granted.
12 In terms of management measures, that
13 really applies to how the QA plan will be applied to
14 criticality safety-related IRFSs. Since we haven't
15 identified specific components relied on for safety,
16 this is more a description of the safety grades and
17 how they apply to criticality controls, rather than
18 specific management measures applied to specific
19 controls.
20 Our technical practices include
21 commitments to ANSI/ANS-8 Series standards for
22 criticality as well as technical requirements on, how
23 do you perform criticality calculations, what type of
24 controls are -- what type of requirements apply to
25 different controls, and so forth?

1 The final one is basically because of the
2 inherent conflict between a desire to use water-based
3 suppression for fire protection and the desire to
4 exclude water for criticality purposes.
5 So if we can go to the next slide, we
6 identified that one of the design bases is
7 identification of the dominant control parameters for
8 the major process areas, and that's really defined at
9 a high level at this point. For instance, we would be
10 talking about controlling mass and geometry for a
11 particular system. It is more at a systems level than
12 at a component level.
13 So we were specifically asked to address
14 the waste processing at the MOX facility. The first
15 thing is, of course, repeating what Drew said, the
16 waste is going to be stored at the MOX facility and
17 it's going to be processed under DOE jurisdiction.
18 So for criticality purposes, the main
19 concern is prevention of getting significant
20 quantities of fissionable material into the waste
21 streams that can then be transferred to unfavorable
22 geometry. The control strategy has been identified as
23 consisting of these items: dual controls and
24 concentration of mass, so that there's at least two
25 barriers prior to getting fissionable material into

1 the waste streams.

2 Here's the double contingency. Rather

3 than identify the specific controls, identify the

4 specific type of controls that will be used, active

5 controls may consist of things like in-line monitors.

6 Passive controls would be items such as siphon breaks,

7 overflows, and so forth. Dual independent sampling is

8 also frequently used.

9 We have bought off that we think this is

10 a reasonable approach.

11 MEMBER WALLIS: What is this waste like?

12 Is it a liquid or slurry, or what is it? Is it a

13 mixture of things? It's piped to DOE. So,

14 presumably, it's a slurry or something?

15 MR. TRIPP: Yes, it would be in a liquid

16 form.

17 MEMBER WALLIS: It's all dissolved?

18 MR. TRIPP: Yes. Well, the waste, for

19 instance, the waste from the aqueous polishing would

20 be, it should be very low-concentration liquids. So

21 the idea is to get the concentration of plutonium

22 to --

23 MEMBER WALLIS: There's no solids that can

24 settle out?

25 MR. MURRAY: If I could just interrupt, my

1 name is Alex Murray. I'm one of the Chem. Safety
2 Reviewers for the NRC.
3 For the waste materials at the proposed
4 facility, they should be clear solutions without
5 solids.
6 MEMBER WALLIS: Thank you.
7 MR. MURRAY: Okay.
8 MEMBER POWERS: Well, to be fair, one of
9 the major concerns you have is that you will, in fact,
10 get plutonium in solution over there and have a
11 precipitation of plutonium hydroxide coming out
12 because you've failed to control the pH of the system
13 properly. But, basically, you're working with clear
14 liquids here. I mean, you hope you're working with
15 clear --
16 MEMBER WALLIS: So there's going to be
17 some assurance that you can keep the liquid clear?
18 MR. TRIPP: Right. That's what these
19 designs are attempting to do. There are filters, and
20 so forth, on the system as well.
21 So this is consistent with what we see in
22 the usual nuclear industry at other facilities, and
23 it's also the same type of approach they've adopted
24 for things like ventilation and reagent recovery
25 systems. So, really, at the design basis level,

1 that's pretty much the extent of what we reviewed at
2 this point.
3 MEMBER FORD: It's pretty well exactly the
4 same process as used at La Hague, materials, controls,
5 for this particular part of it, correct?
6 MR. TRIPP: Yes, the same general
7 approach.
8 MEMBER FORD: And there's been no problems
9 at La Hague, materials problems?
10 MR. TRIPP: Materials problems --
11 MEMBER FORD: Materials of construction
12 problems? I don't know the answer to it. I'm asking
13 you. Have there been problems of materials of
14 construction degradation at La Hague?
15 MR. TRIPP: I'm not sure how that relates
16 to the criticality safety of the waste.
17 MEMBER FORD: Well, it doesn't, not
18 specific to that, but we're just talking about the
19 waste of liquid, clear liquid, and trying to get rid
20 of it. This is not, presumably, water.
21 MR. TRIPP: It's not water, but it's a
22 combination of things that basically has extremely low
23 levels of fissionable materials, so very low amounts
24 of plutonium.
25 So what happens after that is, from my

1 point of view, is not really a concern. Maybe the
2 chemical reviewer could talk more to that.
3 MEMBER FORD: Okay.
4 MR. PERSINKO: I would just like to point
5 out, though, that we did not do a rigorous review of
6 the La Hague plant. I mean we visited the site. We
7 talked with the engineers over there, as well as the
8 regulators. So we are familiar with much of the
9 plant, but we didn't do a rigorous review of the La
10 Hague facility.
11 MEMBER POWERS: I think what it is safe to
12 say is that over the last 40 years we have accumulated
13 an enormous amount of experience working with these
14 particular solutions and liquids and a variety of
15 different materials and what-not. It's probably safe
16 to say that, if the materials are kept within their
17 planned concentrations, that there are no degradation
18 modes, unanticipated degradation modes.
19 MEMBER FORD: That was the point of my
20 question, Dana. All over the world you have had
21 problems of degradation of materials of construction
22 in waste facility plants, just gigantic chemical
23 plants. I'm just pointing to La Hague because that
24 seems the nearest equivalent of any problems.
25 MEMBER POWERS: You can point to the Purex

1 facility and places like that that have had longer
2 lifetimes. What we know is we have become very expert
3 in this because we have made every mistake possible,
4 and sometimes more than once.
5 (Laughter.)
6 But, again, what you can't say now is, if
7 you get outside your range that you have designed this
8 material to, how fast does the material degrade,
9 because I can always say, "Wait, we get farther and
10 farther and farther," and, eventually, yes, you can
11 corrode this material. But if you stay within the
12 range that you expect, you're okay.
13 MR. KLOSKY: Mark Klosky, DCS. I just
14 want to clarify a couple of things about the waste.
15 I think we mentioned the process, that we
16 have the solvent-extraction process that is separating
17 the impurities. In this case that's what we're taking
18 about. Prior to going into the waste, we have
19 monitoring plutonium concentrations. So, with respect
20 to criticality, as Chris indicated, the plutonium
21 concentration is low.
22 I understand your question to be, what are
23 the material concerns? We're using the stainless
24 steel construction, and with respect to safety, we
25 have evaluated consequences and determined that the

1 radiological consequences and chemical consequences
2 that could potentially arise due to leaks do not
3 exceed the performance requirements of Part 70.
4 Further, the material is in an acidic
5 medium; it's a nitric acid medium containing the
6 material, which in this case if we're talking the
7 weapons-grade plutonium, actually has limited
8 quantities of impurities, not the same impurities that
9 accompany the separated nuclear fuel from commercial
10 facilities, which have the added damaging effect of
11 the radiolysis, the radiation damage.
12 So our environment here is actually less
13 corrosive than that of a commercial reprocessing
14 facility, due to the non-inclusion of the fission
15 parts.
16 MEMBER POWERS: First of all, I have to
17 apologize to all the speakers. Dr. Ford asked me to
18 include the materials degradation in the issues that
19 I sent to you, and, of course, I promptly forgot to do
20 it. So he's bound and determined to make me pay for
21 this.
22 (Laughter.)
23 But there are interesting material issues
24 here. I believe it is correct that the stainless
25 steel naturally passivates in sufficiently-

1 concentrated nitric acid and becomes corrosive in
2 sufficiently dilute nitric acid. In addition, there
3 are chlorides and things like that that exacerbate the
4 attack on materials.
5 MEMBER FORD: I guess my final question on
6 this for the time being is: Are all these piping
7 systems inspectable?
8 MEMBER POWERS: Inspectable? That's a
9 good question.
10 MEMBER FORD: Are they above ground, below
11 ground? Where are they?
12 MR. KLOSKY: I will say that one of the
13 PSSCs identified by the applicant is a material
14 surveillance, maintenance and surveillance program.
15 So that is identified as a PSSC.
16 As far as your question about whether all
17 the pipes are inspectable, I don't know, maybe the
18 applicant could answer that, but I believe the pipes
19 in the process cells are not inspectable.
20 MR. ST. LOUIS: I'm Tom St. Louis with
21 DCS.
22 All of the piping and materials are
23 accessible for inspection. We have many components
24 that are in process cells that are normally closed and
25 are not normally accessed, but there is a means to go

1 in for access.

2 All of these areas are monitored for

3 leakage, and if there's leakage, there are procedures

4 planned to shut down the plant and access the area to

5 do repairs.

6 MEMBER FORD: But the waste stream that

7 goes to DOE in the pipeline, above the ground or

8 below, are they inspectable?

9 MR. ST. LOUIS: Yes.

10 MEMBER FORD: That's above ground?

11 MR. ST. LOUIS: No, it's a buried line, a

12 double pipe.

13 MEMBER FORD: It's in a tunnel or

14 something?

15 MR. ST. LOUIS: It's a double-pipe

16 construction, and it is monitored for leakage. Now we

17 actually have three waste streams that go to DOE. One

18 is the high alpha, which is most of the chemical

19 waste; a stripped uranium waste stream, and then we

20 have a low-level waste stream that goes to a different

21 treatment facility.

22 MEMBER FORD: Thank you.

23 MR. TRIPP: I'm now going to discuss a

24 little bit about the one open issue here, which was

25 identified NCS-4 in the draft SER. This relates to

1 the determination of the k-effective limits.

2 The codes that are used to calculate sub-

3 critical limits have different amounts of bias and

4 uncertainty for the different systems. So what DCS

5 has done is they have defined five AOAs, or areas of

6 applicability, to which all the plant processes can be

7 divided.

8 The code has been validated in each of

9 these areas separately and a different upper sub-

10 critical limit determined. Again, this is to ensure,

11 give you a certain amount of confidence that the

12 process is sub-critical if you're below that limit.

13 Another portion of this is that, because

14 the design applications are not exactly identical to

15 the benchmarks, there may be other aspects of the bias

16 that are not taken into account when you do the

17 calculation of the benchmark. So some additional

18 administrative margin is applied.

19 What we have accepted at other facilities

20 is traditionally .05 for the abnormal condition case.

21 In addition, we have had a lot of discussion about

22 what should be the margin for the normal case. An

23 approach that has been adopted at some facilities is

24 that it's been allowed to be determined on a case-by-

25 case basis because some systems are much more

1 sensitive to changes in the system parameters than
2 others in terms of their effect on k-effective.
3 Because this depends on design, it really
4 can't be determined prior to the design. So what we
5 have said, agreed, is that the abnormal condition
6 margin of .05 would be acceptable as part of the
7 design basis, and then some normal margin would be
8 determined as part of the design, depending on the
9 sensitivity of the particular system.
10 So the methodology for doing that is
11 something that we have not gotten a complete handle on
12 as yet. So those are really the two aspects of
13 determining the limits.
14 MEMBER APOSTOLAKIS: So it's essentially
15 expert judgment? I mean, it's not -- is there any
16 supporting calculation that considers possibilities
17 and their likelihood of occurring? I mean, why .05
18 and not .1? How much does that bind?
19 MR. TRIPP: Well --
20 MEMBER APOSTOLAKIS: If I go to .04, am I
21 in trouble?
22 MR. TRIPP: Yes, the value really has not
23 ever had a historical technical basis. It's always
24 been based largely on judgment, and this is throughout
25 the designer history, not just at the MOX plant. It

1 applies to transportation as well. It's in the rule,
2 Part 71.
3 MEMBER APOSTOLAKIS: And it's always .05?
4 MR. TRIPP: Well, no, there are some
5 inconsistencies from one licensed facility to another.
6 MEMBER APOSTOLAKIS: Because it's
7 judgment?
8 MR. TRIPP: That's part of the complexity
9 of this.
10 MEMBER WALLIS: It seems to me in this era
11 it ought to be risk-informed.
12 MR. TRIPP: Well, it ought to be risk-
13 informed. Part of the problem --
14 MEMBER APOSTOLAKIS: Probability-informed.
15 MR. TRIPP: Part of our goal is to make it
16 risk-informed by allowing it to depend on the system.
17 In other words, if you have a system that's very
18 sensitive to changes in k-effective, it should have
19 more margin than a system that's relatively
20 insensitive.
21 MEMBER APOSTOLAKIS: Yes.
22 MR. TRIPP: I think that's where the risk-
23 informing comes in. That could be based on
24 calculations, sensitivity-type calculations.
25 MEMBER WALLIS: Eventually, you have to

1 bring in the awful word "probability."

2 (Laughter.)

3 MEMBER POWERS: I guess I will inject

4 that, historically, we had a couple of criticality

5 events that killed some people, and people found that

6 objectionable and they said, "What do we do about

7 this?" From that, a fairly prescriptive regime was

8 established. The most visible element of that regime

9 is the double-contingency principle.

10 We have established what I would call a

11 standards-based safety system with respect to

12 criticality as opposed to a defense-in-depth or other

13 kind of criticality. Quite frankly, that has served

14 us very well.

15 So I would be reluctant to say, in the

16 name of purity or religious fervor, let's risk-inform

17 this prescription that's come down.

18 MEMBER WALLIS: I don't think that's the

19 idea of any kind of purity. I think you know better

20 what you're doing if you have some measure of the

21 risk. Maybe it's work, but you may be lucky. You

22 know better what you're doing if you have a measure of

23 what you're achieving. I think it's a rational thing.

24 It's not a question of purity.

25 But I don't want to get into a debate with

1 you about that. I would just sort of urge the staff
2 gently in that direction.
3 MEMBER POWERS: Well, before you urge too
4 much, remember, we're doing one MOX facility. I don't
5 think we're planning a regime of MOX facilities. I
6 don't think Drew could stand it.
7 (Laughter.)
8 MEMBER WALLIS: This isn't just for MOX.
9 This is for anything. Whenever you're talking about
10 safety, there ought to be some measure of how safe it
11 is.
12 So let's just go on with it. Okay?
13 MR. TRIPP: One additional thing is that,
14 for the second area of applicability, the MOX pellets,
15 rods, and assemblies, that is equivalent to the low-
16 enriched part of the plant. We're dealing with 6
17 percent material.
18 We've accepted already a margin of .05 for
19 normal conditions for that. So that's how we're
20 attempting to be --
21 MEMBER APOSTOLAKIS: So there is some sort
22 of evaluation -- say, pick one of those, the plutonium
23 nitrate solutions --
24 MR. TRIPP: Right.
25 MEMBER APOSTOLAKIS: -- of how k-effective

1 can approach one? Is there some assessment of how
2 that can happen?
3 (Laughter.)
4 MR. TRIPP: Yes, that's all part of the
5 evaluation process.
6 MEMBER APOSTOLAKIS: What does that
7 include? And why is it an open issue, because they
8 haven't done it or what?
9 MR. TRIPP: It's an open issue primarily
10 because of the lack of benchmarks for plutonium in MOX
11 systems. It makes it much more difficult to validate
12 the codes than for other, for low-enriched or high-
13 enriched fuel applications.
14 MEMBER APOSTOLAKIS: Would humans come
15 into the picture anywhere here, some human error
16 perhaps?
17 MR. TRIPP: Human error?
18 MEMBER APOSTOLAKIS: Well, I mean, is it
19 possible? I don't know how they do it. Or is it all
20 machines?
21 MR. TRIPP: Well, yes, there's humans as
22 analysts. Analysts have to model the systems, and so
23 forth. There's a lot of human judgment that comes
24 into effect
25 MEMBER APOSTOLAKIS: But it cannot affect

1 k-effective?

2 MR. TRIPP: It can affect k-effective.

3 MEMBER WALLIS: That's why we model k

4 greater one, right?

5 MR. KLOSKY: Mark Klosky, DCS.

6 Let me try to differentiate between the

7 probability of moving the system from normal

8 conditions to a limit, and at this point it's .95, for

9 argument's sake. There's a certain sequence of events

10 that have to occur for us to approach .95, and then,

11 as Chris illustrated, there's a certain probability

12 that .95 represents critical.

13 In benchmarking the code, what one does is

14 take critical experiments, determine bias, determine

15 uncertainty, but, as Chris has illustrated, there is

16 an inherent uncertainty, or perhaps beyond which Chris

17 can elaborate, that NRC feels a certain margin needs

18 to be added. You could statistically account for the

19 number of exponents using statistical measures, of

20 course, but I guess the question of representative of

21 the data to the application is where the NRC is, I

22 think, coming from, but I'll let Chris speak to that.

23 MEMBER WALLIS: But if NRC feels it is a

24 good enough margin, that is not a very defensible

25 position.

1 MR. TRIPP: Well, it is a bit of a
2 quandary. There never has been a lot of guidance or,
3 frankly, consistency in approaching this issue.
4 MEMBER APOSTOLAKIS: Is there a place
5 where I can go and understand this issue better? Is
6 there a report that describes all this, how the
7 calculations are done, and so on?
8 MEMBER POWERS: Oh, how the calculations
9 are done?
10 MEMBER APOSTOLAKIS: Yes, and the kind of
11 issues that are taken into account.
12 MEMBER POWERS: Well, I'm not 100 percent
13 sure what you're asking here, but if you want to know
14 how you calculate k-effective -- yes?
15 MEMBER APOSTOLAKIS: No, no, no, no.
16 MEMBER WALLIS: What's the process of
17 evaluating --
18 MEMBER APOSTOLAKIS: The process of doing
19 this.
20 MEMBER WALLIS: Right.
21 MEMBER APOSTOLAKIS: That's the question.
22 I mean, there's must be somewhere where it is
23 described.
24 MR. TRIPP: It is. Well, it's described
25 in the -- first of all, it's described in the Standard

1 Review Plan somewhat. There are also a number of
2 NUREG documents that have been prepared that discuss
3 in-depth validation methodology, and we can provide
4 you references to those.
5 MEMBER APOSTOLAKIS: Good.
6 MR. TRIPP: And the Validation Report, DCS
7 has submitted a Validation Report that goes through
8 this in great detail.
9 MEMBER APOSTOLAKIS: Well, maybe that will
10 be the one.
11 MR. TRIPP: Okay.
12 MEMBER WALLIS: Is there any kind of
13 inspection check that is some sort of an indication of
14 what k-effective you're actually achieving?
15 MR. TRIPP: Not really. I mean, you don't
16 know the true k-effective of the system. That's why
17 you have to back off with a conservative margin. If
18 it goes critical on you, you know you're over one.
19 (Laughter.)
20 MEMBER WALLIS: So that's a yes or no.
21 It's a rather frightening test.
22 CHAIRMAN BONACA: Well, he explained the
23 concern is that you may estimate it is at .95 and the
24 reality becomes critical.
25 MEMBER WALLIS: It may actually be .98.

1 CHAIRMAN BONACA: Okay, so you want to
2 have assurance of margin. The question that's being
3 asked is, could you explain for one of these processes
4 where the issue is? I mean, why are you concerned
5 that the calculation you are making, in planning for
6 that activity, may lead you to a one when you believe
7 that you calculated .95?
8 MR. TRIPP: Well, each of these has a --
9 for each of these areas, there's a number of
10 benchmarks that are analyzed. They calculate
11 k-effective, experiments that have a k-effective very
12 close to one. They calculate a spread in the
13 k-effective values.
14 CHAIRMAN BONACA: Okay.
15 MR. TRIPP: So you apply a statistical
16 methodology to determine sigma on that.
17 CHAIRMAN BONACA: Okay.
18 MR. TRIPP: And there's a confidence limit
19 associated with it. So it's a statistical methodology
20 you go through.
21 MEMBER APOSTOLAKIS: Well, that's what I
22 want to read about.
23 MR. TRIPP: Okay, you can read about that.
24 That's in the Validation Report --
25 MEMBER APOSTOLAKIS: Okay.

1 MR. TRIPP: -- which is separate from this
2 CAR.
3 CHAIRMAN BONACA: Going a step further,
4 the concern now is?
5 MR. TRIPP: Well, the basic concern now,
6 we could look at the next slide. That really
7 illustrates the four areas where we have remaining
8 concerns.
9 CHAIRMAN BONACA: Okay.
10 MR. TRIPP: But they all revolve around
11 the first one, essentially, and it's the lack of
12 plutonium and MOX benchmarks with certain physical
13 characteristics such as benchmark experiments that
14 contain certain absorbers that are desired to be
15 credited; for instance, borated concrete, cadmium,
16 steel, and so forth. Also, benchmarks for certain
17 neutron energies, certain plutonium isotopics,
18 hydrogen-to-Pu ratio and that sort of thing. There
19 are gaps in the data, and there are questions about
20 which benchmarks are applicable in which range.
21 CHAIRMAN BONACA: And you're concerned
22 that, without this validation of the computer code,
23 the computer code may not give you the .05 margin?
24 MR. TRIPP: Right, right.
25 CHAIRMAN BONACA: Okay.

1 MR. TRIPP: Without the validation, you
2 may calculate something as sub-critical when, in fact,
3 it may be critical.
4 CHAIRMAN BONACA: Okay.
5 MR. TRIPP: So I've talked about the first
6 one a little bit. The second one I'll talk about a
7 little bit more is there is a new methodology that's
8 been developed over the past several years by Oakridge
9 National Laboratory, which is sensitivity uncertainty
10 methodology.
11 MEMBER APOSTOLAKIS: So that's available,
12 too?
13 MR. TRIPP: That is. Yes, there are
14 NUREGs that you can read about that.
15 MEMBER APOSTOLAKIS: How many NUREGs? You
16 keep saying, "NUREGs." You have a number of NUREGs
17 for each item? Isn't there a single place where I can
18 go and find out?
19 MR. TRIPP: There are a number of reports
20 that are prepared that all deal with validation
21 methodologies.
22 MEMBER APOSTOLAKIS: A number of them? If
23 I read the latest, would that be okay?
24 MR. TRIPP: Well --
25 MEMBER APOSTOLAKIS: This seems like an

1 overwhelming amount of information. For every item,
2 there's a number of NUREGs.
3 MR. TRIPP: Well, yes, it's a complex
4 process. It's kind of difficult to get your hands
5 around it. That's true.
6 MEMBER WALLIS: How do you train someone
7 to do it?
8 MR. TRIPP: Experience, using the code --
9 MEMBER POWERS: I'm going to have to ask
10 members to move right along. We've got more
11 contentious issues ahead.
12 CHAIRMAN BONACA: I think the most
13 important point right here for the Committee is to
14 understand how far are you from resolving these open
15 -- well, how far are they from resolving these open
16 issues? You have a history here in the back of how
17 you raised the issue; you received information and --
18 MR. TRIPP: Yes, why don't we turn to
19 that --
20 CHAIRMAN BONACA: Okay.
21 MR. TRIPP: -- because you can ask any
22 specific questions about those issues, but I'll move
23 along here.
24 We received the latest revision of the
25 Validation Report in January. We had received a

1 couple of prior revisions. It comes in three parts,
2 and it's separate from the CAR. I think one of them
3 is on the third revision now.
4 But we received the latest version in
5 January. We had a meeting in March to discuss the
6 major issues which appear on the previous slide, and
7 we received the SCALE 5 code from Oakridge in May.
8 That's been under development. It has not been
9 released to the criticality community for general use.
10 We're the only ones, outside of the developers, that
11 have access to it at this point in time.
12 We are using it to do our independent,
13 confirmatory calculations.
14 MEMBER RANSOM: Isn't that a DOE code?
15 MR. TRIPP: Yes. It's prepared by
16 Oakridge under contract to NRC.
17 MEMBER RANSOM: Okay.
18 MR. TRIPP: And it was also used by
19 Oakridge as part of supporting the DCS submittal for
20 the part that deals with MOX and plutonium powders.
21 We issued an RAI. I should point out that
22 we have only -- we had actually received an updated
23 version of the Validation Report addressing these
24 issues within the last week. So we're in the early
25 stages of reviewing it.

1 They appear to redefine some of the ranges
2 of parameters to much narrower ranges in some of the
3 parameters, and it looks as though that may address
4 some of our issues.
5 MEMBER WALLIS: Do they monitor how well-
6 mixed the powders are? That must have a great effect
7 on criticality?
8 MR. TRIPP: Yes.
9 MEMBER WALLIS: Are they monitoring it all
10 the time of how well-mixed the powders are?
11 MR. TRIPP: Yes. Well, from the point
12 where the powders, where the depleted uranium and
13 plutonium powders are blended together, the
14 homogeneity is very important.
15 MEMBER WALLIS: Yes.
16 MR. TRIPP: It has a big effect on
17 criticality.
18 MEMBER WALLIS: It's monitored all the
19 time? It is monitored?
20 MR. TRIPP: Yes, it will be monitored.
21 The amounts of uranium and plutonium will be monitored
22 that are going into the tank.
23 MEMBER WALLIS: And how well-mixed it is
24 very important?
25 MR. TRIPP: Right. Right, it has to have

1 the right moisture content. They have a mechanical
2 stirrer, and so forth. I believe it's also sampled to
3 ensure that.
4 MEMBER RANSOM: Will Framatone be using
5 French data or is there any French data on this
6 process, criticality, I guess, data?
7 MR. TRIPP: Are you referring to benchmark
8 experiments?
9 MEMBER RANSOM: Right. Well, benchmark
10 codes, I guess.
11 MR. TRIPP: Well, they're actually using
12 a different code than what the French used. They're
13 using the SCALE code, which is an American code. The
14 French use the Apollo code, which is the French code.
15 So although they're doing the design, they're using
16 different tools to do so; plus, we have different
17 isotopics. So for the ranges the physical parameters
18 are somewhat different.
19 So, in conclusion, we found the
20 acceptability of all the design bases except for the
21 k-effective limit. We knew very early on in the
22 review -- in fact, before we even started working on
23 the MOX -- that this would be probably the most
24 challenging part for criticality safety, due to the
25 scarcity of available benchmarks.

1 We are in the process of reviewing the
2 Validation Report, the most recent one that was just
3 submitted in July, and we are using this new code to
4 resolve some of the open issues. Hopefully, we'll
5 have it resolved by September.
6 MEMBER RANSOM: How is this related to --
7 at least from my experience, most criticality
8 accidents have happened as a result of inventory
9 control problems, you know, in different parts of the
10 process.
11 MR. TRIPP: Right.
12 MEMBER RANSOM: And you want to prevent
13 accumulation. So is this tied in with some kind of
14 inventory control process?
15 MR. TRIPP: Yes. For instance, in the
16 blending, you're measuring -- you have like a flow
17 totalizer to measure the amounts of powder that are
18 going into the blend tank, or in the glove boxes you
19 have mass limits. So it requires you to track the
20 amount of material.
21 Then in the ventilation, we're using this
22 same philosophy we're using for the waste storage,
23 where we have two barriers. So there could be a slow
24 accumulation over time, and I would expect that to be
25 monitored, but we haven't received detailed

1 information at this stage, at the CAR stage on that.
2 MEMBER POWERS: I would like to move on to
3 the next topic, if we could.
4 MEMBER WALLIS: Well, things are going to
5 heat up a bit.
6 MEMBER POWERS: Is this fire safety?
7 MEMBER WALLIS: Yes.
8 MR. WESCOTT: Hi. My name is Rex Wescott.
9 I'm the ISA Reviewer, and I'll be talking about the
10 MOX fire protection review.
11 Next slide. There was concern in the
12 Subcommittee about the plant's design basis in regard
13 to fire. 10 CFR 70 does not contain explicit
14 requirements for facility fire protection analogous to
15 what you might find in 10 CFR 50.48 or Appendix R.
16 Instead, fire protection is implicitly addressed by
17 the performance requirements.
18 The applicant must assure that 10 CFR 76
19 requirements are complied with under all credible fire
20 scenarios. At the MOX facility, this compliance is
21 assured through a combination of prevention, and I
22 define "prevention" as no incipient fires. In some
23 areas, prevention can be no emission sources, but I
24 think overall no incipient fires is probably a good
25 definition for prevention.

1 We define prevention in the AP process
2 cells, where actually emission is prevented, and you
3 find prevention in the inerted glove boxes, glove
4 boxes that are inerted by nitrogen. So if you do have
5 an ignition source, you won't have a fire.
6 Another means of fire protection and
7 suppression and/or combustible loading controls -- and
8 I put these together because what they do is they
9 allow a fire, but they don't allow a fire that's going
10 to lead to a release. And you find this --
11 MEMBER WALLIS: Another method of sort of
12 prevention is this requirement to keep the temperature
13 of liquids five degrees below the flash point? That
14 would seem to me a pretty small margin.
15 MR. WESCOTT: I'm not sure about -- well,
16 I mean keeping liquids below the flash point is
17 certainly a means of fire protection because, after
18 all, if you get to the flash point, you still need an
19 ignition source to start a fire. I mean, just
20 allowing the liquid to get above the flash point is
21 not going to start a fire in itself.
22 MEMBER WALLIS: I just wondered. It just
23 struck me that five degrees didn't seem to be much
24 margin.
25 MR. KLOSKY: This is Mark Klosky, DCS.

1 We've had recent communications with NRC.
2 We're amending that response. We're going to an LFL
3 argument, and it's --
4 MEMBER WALLIS: A what argument?
5 MR. KLOSKY: Based on the percentage of
6 the flammability limit.
7 MEMBER WALLIS: Flammability?
8 MR. KLOSKY: Yes. So we are going to
9 amend that response. We're working with NRC. It's an
10 open item.
11 MEMBER WALLIS: Thank you.
12 MR. WESCOTT: Yes, I think that's a
13 chemistry open item, is probably one of the reasons
14 I'm not terribly familiar with it.
15 We define suppression and combustible
16 loading controls in the truck base, the secured
17 warehouse. In the glove box area, you have clean
18 agent suppression because they are moderator control
19 areas, and you have, basically, combustible loading
20 controls in the fuel rod and canister storage areas.
21 Now the third means of fire protection is
22 fire barriers. What fire barriers do is confine the
23 internal fire to one fire area, and where the fire can
24 be tolerated, and you also protect against external
25 fires using fire barriers.

1 Go to the next slide. The fire protection
2 strategy for MOX does not incorporate a universal
3 design basis fire, such as, say, a 1-kilowatt power
4 fire for one hour or something analogous to that.
5 But we do have the fire protection
6 strategy dose incorporate some quantitative values.
7 For example, fire area boundaries are a minimum of a
8 two-hour fire, as per ASTM E-119. Compartment air
9 temperatures into the ventilation system are limited
10 to 2,000 degrees Fahrenheit. That's at the intake, to
11 protect the final HEPA filters. The dilution of the
12 air brings it down to less than 400 degrees, which is
13 the design basis for the filter at the final filters.
14 We have some material confinement
15 barriers, like the various transport casks, which are
16 actually as per DOE design. They do have a
17 temperature and time limit on them. So the idea there
18 is to make sure that the fire in a compartment
19 affecting these particular transport casks is limited
20 by controls or suppression to something less than that
21 temperature --
22 MEMBER WALLIS: It's a strange number.
23 It's 800 degrees C.
24 MR. WESCOTT: Yes, 800 degrees C is right.
25 (Laughter.)

1 That's right. I'm sorry, I stuck with
2 English units here.
3 The next slide. The one remaining open
4 item in fire protection is that the applicant has
5 evaluated fire scenarios where temperatures could
6 exceed the E-119 curve. What we're concerned here is
7 the possibility that the very fast rise in
8 temperature, primarily due to liquid hydrocarbon
9 fires, could put a stress on the wall that's not
10 really being taken into account with a standard fire
11 test. What we need is a demonstration or an
12 evaluation, an explanation, that the fire barriers can
13 withstand the rapid fire development without
14 compromising their integrity.
15 Next slide. Now I'm going to replace this
16 slide with a slide I prepared last night from a
17 response we got from the licensee that may better
18 explain the problem. This is really more of a cartoon
19 than an actual presentation of the problem.
20 MEMBER APOSTOLAKIS: I'm just curious,
21 while they are getting ready: We had a presentation
22 by the staff two or three years ago, when they were
23 talking about their fire research program, and there
24 were all sorts of limitations listed in the standard
25 fire curve. Now we turn around and use it.

1 MR. WESCOTT: Okay, maybe I'll have to go
2 back to the other slide.
3 (Laughter.)
4 But this is the licensee's response to us.
5 MEMBER APOSTOLAKIS: Okay.
6 MR. WESCOTT: This is the E-119 curve.
7 This is a standard curve. These are the results of
8 some of their fire modeling.
9 Now, with hydrocarbons, the type of curves
10 they're getting there is not unexpected. In fact,
11 that's always been a trouble with the E-119 curve when
12 you're dealing in the petroleum industry, and the
13 petroleum industry has really done a lot of research
14 and has developed some new rating curves. In fact, I
15 think they've developed a 1708, D-1708, curve, which
16 is shown on the slide I just had taken off.
17 In fact, if we could go back to that slide
18 now, it will show the problem. This is the E-119.
19 This is the D-1708 that was developed I think
20 primarily by the petroleum industry. What we're
21 hoping is that, maybe by comparing the walls -- well,
22 it's really up to DCS how they want to deal with this
23 problem, but one possible solution may be to compare
24 their walls with walls that meet this hydrocarbon
25 curve and be able to show that, not only would the

1 wall withstand an E-119 curve fire, but would also
2 withstand a hydrocarbon-type fire.
3 MEMBER APOSTOLAKIS: So remind me what the
4 curve means to begin with.
5 MR. WESCOTT: Well, it's temperature
6 versus time.
7 MEMBER APOSTOLAKIS: Yes, and what does
8 that mean?
9 MR. WESCOTT: Well, what they do, how they
10 run a fire test, is they have these furnaces, and this
11 curve was developed, oh, probably in the 1920s or so
12 from what they called "fire crib tests," where they
13 set on fire cribs of wood that they think will
14 approximate what you would find in a building, a
15 house, and measure the temperatures.
16 Well, once this curve is established, then
17 in your testing facility you have gas furnaces and you
18 fire these, so that the temperatures are met as a
19 time. You have a wall. Say you're testing a wall.
20 You have a wall set up, and you have thermocouples on
21 the other end of it, on the other side of it.
22 The criteria is normally 325 degrees
23 Fahrenheit because that's often the point where paper
24 or other ordinary combustibles will catch on fire.
25 MEMBER APOSTOLAKIS: Yes.

1 MR. WESCOTT: So to pass the rating, it's
2 got to withstand, you know, it's got to stay below 325
3 on the other side, and then just to make sure, they
4 hit it with a fire hose after it's all fueled. That
5 kind of shows that it has maintained its integrity.
6 MEMBER APOSTOLAKIS: What are the units in
7 time? I can't read it.
8 MR. WESCOTT: Oh, those should be hours.
9 Well, let me see, I don't know whether it's --
10 MEMBER APOSTOLAKIS: It's longer than
11 hours.
12 MR. WESCOTT: No, in minutes, I guess.
13 Minutes, minutes, those are minutes. Let me see if I
14 have --
15 MEMBER APOSTOLAKIS: So I have a fire on
16 one side for 20 minutes at a certain temperature, then
17 if I follow this curve, I'm guaranteed that the other
18 side of the wall will be 300 degrees or something?
19 MR. WESCOTT: That's right, or less.
20 That's the whole intent.
21 And that concludes my presentation.
22 MEMBER POWERS: We have had, in our
23 discussions, one other issue having to do with the
24 suppression system being used in some of the
25 compartments, where they were using this --

1 MR. WESCOTT: Intergen? Right.

2 MEMBER POWERS: -- Intergen gases. The

3 question was one really of rediffusation, and what-

4 not.

5 MR. WESCOTT: Right.

6 MEMBER POWERS: Have you looked at that at

7 all?

8 MR. WESCOTT: Well, we had the Intergen

9 people in and we were talking to them. I think

10 Intergen works very good on normal diffusion flames

11 like you get from hydrocarbons or a lot of

12 combustibles burning. They didn't completely address

13 what it would do to a smoldering-type fire, which I

14 think is what you're concerned about.

15 In my opinion, and I don't know how Sharon

16 is going to deal with this, but I think before we

17 really determine whether Intergen is proper or not, we

18 have to know exactly what kind of combustible we're

19 talking about in the compartment. Intergen is still

20 probably going to be useful for knocking down the

21 initial fire. I mean, it may be very possible to

22 knock down the fire with Intergen and then go in there

23 manually and use other agents.

24 That gets into the pre-fire planning that

25 is normally taken in a licensing stage. So I don't

1 think it's a serious problem. Personally, I think
2 Intergen would probably work to knock down a
3 hydrocarbon fire --
4 MEMBER POWERS: No question.
5 MR. WESCOTT: -- you know, quickly,
6 provided you take out all the delays and aborts and
7 that kind of thing that you normally find with the
8 gassing systems, but that can be done.
9 So there are solutions, but, yes, as far
10 as the inability to put out a smoldering, deep-seated
11 fire, we haven't resolved that yet with a gaseous
12 agent.
13 MEMBER POWERS: Okay.
14 MEMBER WALLIS: I'm sure we need to move
15 on. Did you resolve the soot, the soot in the
16 filters?
17 MR. WESCOTT: Yes, that's been resolved.
18 MEMBER WALLIS: Okay, thank you.
19 MR. WESCOTT: Is that it?
20 MEMBER POWERS: Steve, you didn't have any
21 other additional comments?
22 MEMBER ROSEN: No. I was going to ask
23 about the soot question as well.
24 MEMBER POWERS: Okay. We'll move now to
25 one of my favorite topics, Red Oil.

1 MR. MURRAY: Okay, thank you very much.
2 Good morning. My name is Alex Murray. My colleague
3 is Bill Troskoski. We have been working with other
4 members of the NRC staff reviewing chemical safety and
5 related issues. The one I'm going to talk about this
6 morning is Tributyl-Phosphate-Nitric Acid reactions,
7 often referred to as "Red Oil".
8 Next slide, please. On this slide I just
9 summarize a very quick description of what a Red Oil
10 is. It is a chemical reaction between Tributyl-
11 Phosphate and organic materials and Nitric Acid and
12 nitrate materials.
13 MEMBER APOSTOLAKIS: So the reaction
14 itself is the oil, Red Oil?
15 MR. MURRAY: Well, "Red Oil" as a term is
16 just, if you will, a nickname that was given to some
17 events, and in some experimental testing to try to
18 replicate the phenomena a reddish color has been
19 observed.
20 MEMBER APOSTOLAKIS: But when you say,
21 "Red-Oil," you refer to the reaction?
22 MR. MURRAY: Yes.
23 MR. TROSKOSKI: Yes, it's a Red-Oil
24 reaction --
25 MR. MURRAY: Yes.

1 MR. TROSKOSKI: -- similar to many others
2 in the chemical processing industry.
3 MR. MURRAY: Yes, yes. It is a chemical
4 reaction.
5 One of the things about the reaction is,
6 like many chemical reactions, it can generate heat,
7 thermal energy, and non-condensable gases, which can
8 pressurize vessels and containers.
9 As with many chemical reactions, its rate
10 depends on a number of factors: the chemical species
11 which are present, the concentrations, and
12 temperatures and pressures, and so forth. Impurities
13 can exacerbate the phenomena. Primarily, metal irons
14 tend to work in a way like a catalyst.
15 MEMBER POWERS: I have seen some speculate
16 that, in fact, you have to have radiolysis or a
17 radiolytic decomposition products, in fact, to have
18 that.
19 MR. MURRAY: The phenomena has been
20 duplicated in tests without radioactive materials, but
21 definitely a radiolysis does exacerbate the phenomena,
22 yes. Yes, no doubt about it.
23 MEMBER POWERS: And in this particular
24 system, we don't have the kind of radiolysis you have
25 in fuel recovery systems?

1 MR. MURRAY: One does not have the gamma-
2 type radiolysis and fission product, but one can have
3 the intense alpha radiolysis.
4 MR. TROSKOSKI: Which is why the applicant
5 has done a controlled residence time and exposure --
6 MR. MURRAY: Right, right.
7 MR. TROSKOSKI: -- to limit that damage.
8 MR. MURRAY: Yes, that was a proposed
9 control for the applicant on radiolysis.
10 The key concern about the Red-Oil
11 phenomena is it can be potentially explosive and cause
12 damage to system components.
13 The next slide, please. This is just a
14 little summary of the background of why we are
15 concerned about Red Oil. There have been four
16 reported accidents with equipment damage and release
17 of materials within a facility and/or on site. There
18 has been one accident where there has been a
19 significant offsite release, and that was in 1994 at
20 Tomsk, in the former Soviet Union.
21 If you look at the historical record of
22 the reports of incidents where operators have noticed
23 pressure fluctuations or have heard odd sounds coming
24 from equipment, the conclusion has been that has been
25 a Red-Oil event that started but did not propagate

1 through to an explosion.

2 Now the applicant, DCS, has recognized the

3 Red-Oil phenomena as an explosion event or potential

4 explosion event, and they have proposed a prevention

5 strategy to protect the facility worker, the site

6 worker at the DOE site, the public, and the

7 environment.

8 MEMBER WALLIS: Can I ask you, is there a

9 science for predicting these things? Is this chemical

10 kinetics and all that kind of stuff?

11 MR. MURRAY: There is some science to it.

12 There is a lot of empirical test data which is

13 available as well. There are operating guidelines, if

14 you will, controls which are used by the Department of

15 Energy in their facilities.

16 MEMBER WALLIS: So a lot of it is

17 empirical?

18 MR. MURRAY: Yes.

19 MEMBER WALLIS: Yes?

20 MEMBER POWERS: We should interject here

21 that in one of our Subcommittee meetings the licensee

22 brought forward its chemical staff who are undertaking

23 what I would say is one of the more mechanistic

24 assaults on the issue. I think that's more of a

25 longer-term effort than it is going to resolve this

1 particular design bases.

2 There have been episodic attempts to try

3 to develop an acute mechanistic approach. Quite

4 frankly, the presentation that was made by the

5 applicant was one of the better ones I had seen in

6 this effort, but you can't hope -- I think we would be

7 foolish to hope for mechanistic understanding of this

8 mysterious issue in the near-term.

9 MEMBER RANSOM: Is this a reaction between

10 miscible or immiscible components? Is it like a

11 solid-liquid phase reaction or liquid-liquid?

12 MR. MURRAY: Liquid-liquid-based reaction.

13 MEMBER RANSOM: So they are miscible in

14 phases, basically? Maybe?

15 MR. MURRAY: There's some cross-

16 solubility, but most of the reaction appears to occur

17 in the organic phase.

18 MR. TROSKOSKI: And, again, there are a

19 lot of intermediates that would be in the gaseous

20 phase.

21 MR. MURRAY: Yes. One of the things to

22 remember about the Red-Oil phenomena is it includes a

23 lot of intermediates of different types of species.

24 Their formation rates and their relative quantities

25 depend very heavily on the specific environment at the

1 time.

2 MR. TROSKOSKI: You have TBPs, butyls --

3 MR. MURRAY: Yes.

4 MR. TROSKOSKI: -- and a whole host of

5 other characters that interact in different parallel

6 paths.

7 MR. MURRAY: Yes.

8 MEMBER RANSOM: Is the gas phase a product

9 of the reaction or does it participate in the

10 reaction?

11 MR. MURRAY: Yes.

12 MR. TROSKOSKI: Yes to both really.

13 MR. MURRAY: Exactly, exactly.

14 MR. TROSKOSKI: That's why it's so

15 complicated.

16 MR. MURRAY: Yes. At the gas phase,

17 reactions can actually exacerbate the consequence of

18 the phenomenon.

19 MR. TROSKOSKI: Some of the experiments

20 they have done, for example, if you have adequate

21 venting and you're pulling off the intermediates, you

22 will only get just maybe 10 or 15 percent of the

23 theoretical amount of heat generated because the

24 reaction doesn't go to completion because of the

25 contribution of the volatiles that are being pulled

1 off. That's why when we get to venting it's so
2 important. It actually lowers the available energy of
3 the reaction because it can't all go to completion.
4 MR. MURRAY: May I have the next slide,
5 please? Okay, on this slide we have summarized the
6 applicant's approach. The applicant has proposed
7 three PSSCs, principal structure, systems, and
8 components, with five safety functions to address and
9 prevent the phenomena. The applicant has also made a
10 distinction about open versus closed systems, which I
11 will discuss a little more in a moment.
12 The PSSCs, the offgas system, the process
13 safety control subsystem, and the chemical safety
14 control system, which is an admin. control. I have
15 listed the safety functions there.
16 Next slide, please. On this slide I have
17 just put forth the definitions of open and closed
18 systems that the applicant is using. For an open
19 system, it is capable of fully venting the runaway
20 reaction, if you will, the Red-Oil reactions
21 themselves which generate these intermediates and
22 flammable gases, and this is heavily based upon
23 experimental results conducted for the Savannah River
24 site. The safety factor is approximately 2.5 over the
25 minimum required. It also assumes the presence of 100

1 percent of organics in any of the vessels, which would
2 be categorized as open systems.
3 Closed systems, however, are defined a
4 little differently. Rather than being based on their
5 capabilities of venting, they are based on their
6 abilities to mass-transfer material out, so that you
7 have evaporative cooling of the system. Evaporative
8 cooling means you stay, remain at the nitric acid
9 water azeotrope temperature, or you do not exceed it,
10 which is approximately 120 degrees Centigrade.
11 Now in a closed system the vessel can have
12 significant fractions of organic materials. The
13 applicant just mentioned tens of a percent, but the
14 vessel itself cannot be 100 percent full of organic
15 material.
16 They have proposed a safety factor, based
17 on essentially a heat balance, if you will, of 1.2
18 times the energy input into the system from external
19 heatings, such as via steam heating, plus the energy
20 generated internally by the Red-Oil reaction.
21 MEMBER WALLIS: This is a safety factor on
22 the energy balance --
23 MR. MURRAY: Yes.
24 MEMBER WALLIS: -- to keep it cool?
25 MR. MURRAY: Yes, yes. And a key

1 distinction between a closed system as compared to an
2 open system is that, if a Red-Oil reaction starts
3 initiating in a closed system, the system itself is
4 not capable of fully venting the runaway reaction. So
5 it could pressurize.
6 MEMBER WALLIS: So runaway reaction is
7 different from just maintaining an energy balance?
8 It's like whether a fire initiates or not? So it's
9 the rate of change of energy production with
10 temperature and things like that?
11 MR. MURRAY: That's correct.
12 MEMBER WALLIS: You have to analyze that
13 whole thing?
14 MR. MURRAY: Yes. The chemical reactions
15 do increase their rates exponentially with
16 temperature. Usually, we use an Arrhenius type of
17 relationship, yes.
18 The next slide, please.
19 MEMBER WALLIS: This looks like a no-no,
20 this last bullet here.
21 MR. MURRAY: I'm sorry?
22 MEMBER WALLIS: This is a real no-no. I
23 mean, you're supposed to be able to vent a runaway
24 reaction, aren't you?
25 MR. MURRAY: That is the distinction

1 between an open and closed system. With a closed
2 system, the concept is that you have sufficient
3 evaporative cooling and mass-transfer of reactants
4 out.
5 MEMBER WALLIS: You stay away from the
6 runaway reactions?
7 MR. MURRAY: That is correct.
8 MEMBER WALLIS: If you did get it, it
9 would blow up the vessel?
10 MR. MURRAY: If the venting becomes
11 inadequate, you could overpressurize the vessel, yes.
12 MEMBER ROSEN: Would you actually
13 overpressurize the vessel or are there relief
14 features?
15 MR. MURRAY: At this time we're looking at
16 this from more of a systems approach. At the ISA or
17 operating licensing stage, we would look at specific
18 components. It is likely there would be some form of
19 relief devices.
20 MEMBER WALLIS: So you're working on that?
21 MR. MURRAY: Yes.
22 MR. TROSKOSKI: If you recall, they still
23 have committed to do a haz op as part of the ISA, and
24 for unit operations that's where you really get your
25 -- you nail down the safety of the system ops at that

1 stage. That's when they will determine whether or not
2 they actually have to go back and change some of the
3 PSSCs; that's recognized in the regs.
4 MEMBER ROSEN: Well, that's a complicated,
5 convoluted answer to a simple question. The question
6 is: Would you put on relief devices if you predicted
7 that under certain circumstances the system could
8 pressurize?
9 MR. TROSKOSKI: That would be one pathway
10 you could take. Another pathway would be cooling of
11 some sort.
12 MR. KLOSKY: This is Mark Klosky, DCS.
13 To address your question, our alternative
14 is to put additional features, IRFS, to further reduce
15 the frequency of that runaway reaction to the point
16 that we meet the performance requirements. So I think
17 the NRC had alluded to our safety strategy as one
18 based on prevention of the runaway reaction, both in
19 the case where we have an open system and also even in
20 the event that the system is closed. Or I should say
21 it the other way around.
22 But the principal SSCs that we have
23 proposed act towards preventing a reaction from the
24 point at which it would overpressurize the system. So
25 we have redundant temperature systems to shut the

1 system and basically never get to the point that the
2 runaway reaction is such that it accelerates.
3 In addition, we have a means to provide
4 the cooling, such that we don't exceed the boiling
5 point of the solution, and that is via the evaporative
6 cooling. So in either case, we have multiple features
7 to preclude the runaway reaction.
8 MEMBER ROSEN: I guess you're one of those
9 people who doesn't believe in defense in-depth.
10 MR. KLOSKY: No, I think we do. I think
11 our defense-in-depth feature, in fact, is -- we have
12 credited our filtration system as providing defense
13 in-depth in fact.
14 MEMBER ROSEN: Filtration?
15 MR. KLOSKY: Our HEPA filters. So even if
16 the event does occur, the radioactivity will be
17 confined.
18 MEMBER ROSEN: In other words, it will
19 explode the vessel? The vessel explodes --
20 MR. KLOSKY: Correct.
21 MEMBER ROSEN: -- and into the cell?
22 MR. KLOSKY: Into the cell.
23 MEMBER ROSEN: And probably ignites a
24 fire, and then the HEPA filters ultimately control the
25 release?

1 MR. KLOSKY: That's correct.

2 MEMBER POWERS: I have to admit that, in
3 thinking about this issue, what you have outlined
4 there is a fairly classic approach to defense in-
5 depth; that is, you've established one barrier. If
6 that fails, you have yet another independent barrier.

7 In thinking about it, I thought
8 microscopically in terms of temperature control and
9 purity control on the Tributyl-Phosphate as defense-
10 in-depth measures.

11 MEMBER ROSEN: So what is this
12 extraordinary, even heroic, approach rather than
13 preventing explosion in the first place, preventing
14 pressurization by simply having a relief device? I
15 mean, what is it about rupture disks or something like
16 that that is an anathema to you, to the applicant,
17 and, presumably, to staff's acceptance of it? I mean
18 rupture disks are used all the time in the
19 industry for prevention of explosion of vessels that
20 are overpressurized.

21 MR. MURRAY: If I can continue -- well, I
22 think the applicant is going to address your question.

23 MR. KLOSKY: Yes. There are two aspects
24 to that. I think, as the NRC has discussed, some of
25 the intermediates are volatile, butane, for example.

1 So one might be able to accommodate the
2 overpressurization, but previous events have, in
3 essence, released quantities of butane. They didn't
4 overpressurize the system but they had subsequent
5 explosions.
6 So the fact of the matter is you lead to
7 basically put the multiple layers of protection to
8 preclude the event, and then, in fact, if the event
9 occurs, to have the means to filter any radiological
10 release.
11 So, in other words, simply making a vent,
12 you know, three inches larger doesn't get you out of
13 the woods in all cases. We have very combustible
14 gases that are released as well that we have to
15 account for in any highly unlikely case where we do
16 have a runaway reaction. So that's our approach to
17 defense in-depth.
18 MEMBER ROSEN: Okay. You're saying that,
19 if you release the contents of this vessel that's
20 running away, it would explode anyway?
21 MR. MURRAY: I'm not quite sure what you
22 mean by "release the contents," but if I can --
23 MEMBER ROSEN: The vessel is pressurizing.
24 MR. MURRAY: Yes.
25 MEMBER ROSEN: You insist on -- there's no

1 sort of rupture disk or relief valve because what I
2 understand from this response is that, under those
3 circumstances, if you did vent that vessel, the
4 products that came through the vent, when they hit,
5 presumably, the environment in the cell would explode
6 anyway?
7 MR. MURRAY: It depends on many factors.
8 It depends on the rates of generation, the back-
9 pressure that exists before the relief or the device
10 actuates, and so forth. It's a complex phenomenon.
11 MR. TROSKOSKI: It's the rate of reaction
12 that you're worried about because you're always going
13 to have that reaction going, a certain amount of it,
14 at the lower temperatures and concentrations and
15 pressures. But one of the things they found is that,
16 if you have a back-pressure on it, you've got a
17 controlled reaction going; you're removing the heat
18 that's being generated, but if somehow you were to
19 back-pressure it up to even two atmospheres, you would
20 concentrate the gaseous face and increase the kinetics
21 such that you would not take off and go to a runaway
22 condition.
23 So to say venting to prevent
24 overpressurization, that will not necessarily
25 terminate the reaction once it starts if you've got a

1 critical back-pressure that's been built in there.

2 MEMBER ROSEN: So that's a much better

3 answer to me. It is that the rate of reaction is so

4 high under certain circumstances --

5 MR. TROSKOSKI: Yes, and pressure, too --

6 MEMBER ROSEN: -- a rupture disk would not

7 be able to sense it quickly enough to prevent the

8 destruction of the vessel in any --

9 MR. TROSKOSKI: Exactly. That's why

10 you've got to prevent it from going over the edge to

11 begin with, yes.

12 MEMBER ROSEN: Now I have some sort of

13 physical understanding of what you're dealing with.

14 CHAIRMAN BONACA: We've got a problem

15 because we have right now four minutes left on the

16 agenda and we have almost half the presentation in

17 front of us.

18 MR. MURRAY: Actually, I'll go. The next

19 slide, please.

20 MEMBER WALLIS: This will be resolved by

21 September is really what we need to take away, is it?

22 MR. MURRAY: To help assist the staff in

23 evaluating this, the staff has conducted a top-level

24 fault tree analysis. I just have pulled two sections

25 from the tree. This shows the split between open and

1 closed systems.

2 For open systems, the staff has concluded
3 that the control strategy proposed by the applicant
4 gives adequate assurance. However, for the closed
5 system, the staff still has a lot of questions and
6 currently has not made a conclusion of adequate
7 assurance.

8 If I could have the next slide, please?
9 As part of this top-level fault tree analysis, we did
10 develop a tree through for the closed system, and what
11 we found was that there are essentially three reaction
12 schemes or areas or types of reactions which seem to
13 occur and contribute significantly to the phenomena.

14 There's a lower-temperature route, which
15 becomes very significant about 90 to 100 degrees
16 Centigrade. There's a middle-temperature route, which
17 becomes extremely significant somewhere around 130
18 degrees Centigrade, and then there's a high-
19 temperature group of reactions, which starts becoming
20 significant at about 150 degrees Centigrade.

21 The staff has found that for the middle
22 group of reactions, which becomes significant at about
23 130 degrees Centigrade, in closed systems that we have
24 concerns about adequacy of meeting the prevention
25 strategy.

1 The next slide, please. On this last
2 slide, I'm just summarizing the staff conclusions and
3 concerns to date. With an open system, the staff has
4 found that the approach appears capable of meeting the
5 highly-unlikely likelihood if such a system is
6 designed and proposed at the operating license stage.
7 However, the closed system approach the
8 staff does not currently accept. We're still doing
9 some evaluations, and we are having discussions with
10 the applicant about this. We are concerned that, at
11 least based upon our analyses and our understanding of
12 the phenomena and a look at analogies which are
13 available that deal with facilities, for example, that
14 the likelihood of the closed system of limiting or
15 preventing this event is not highly unlikely.
16 We are concerned about some differences
17 between this closed system approach as compared to
18 existing facilities such as at the DOE Savannah River
19 site. We have noted that a lot of the concerns seem
20 to come down to some limitation on the reaction rates,
21 such as limiting the temperature, if you will, the
22 solution temperature that could be in the vessels or
23 in the evaporative.
24 Now, currently, the applicant is to
25 provide additional information based upon some reviews

1 and contacts they are making for existing facilities
2 which exist around the world.
3 And that concludes my presentation.
4 MEMBER POWERS: Any additional questions?
5 MR. MURRAY: Any questions?
6 MEMBER WALLIS: I know we want to move on.
7 I just hope that, when we do resolve this issue, there
8 is some information in there, so there's a place where
9 we can find it, so that we can look at it, if we have
10 questions about the runaway reaction, and so on.
11 Actually, a document would --
12 MR. MURRAY: Yes, you are aware that the
13 staff has two draft Safety Evaluation Reports, and
14 those have --
15 MEMBER WALLIS: But not just words, but
16 actually see some curves and analysis?
17 MR. MURRAY: Yes.
18 MEMBER WALLIS: Okay, thank you.
19 MR. MURRAY: Yes. You're welcome.
20 MEMBER POWERS: Drew, I suggest that we
21 move immediately to your concluding remarks on the
22 remaining open items.
23 MR. PERSINKO: One thing I do want to say
24 is I think I heard one of the members say that this
25 will be closed by September. I don't know if it will

1 be closed by September. It may; it may not.

2 All I can say is, as with all the open

3 items, we are continuing a dialog with the applicant.

4 In some cases I think the open items are closer to

5 resolution than others, but I can't guarantee that

6 they will be closed by September.

7 Okay, let's talk very briefly, then, about

8 the remaining open items. Staff had a concern

9 concerning titanium fires, the possibility of titanium

10 fire igniting. Staff has adopted a prevention, has

11 accepted a prevention strategy.

12 DCS proposes to use NFPA 70 regarding

13 overcurrent protection ground faults in electrical

14 system coordination. Staff is looking at that. Staff

15 is discussing whether or not perhaps IEEE 242 would be

16 a better standard for protective devices, and we are

17 continuing to discuss that with the applicant.

18 The UO 2 burnback issue, MP-1, the issue

19 here is that potentially UO 2 particles could be

20 oxidizing and could travel through the ventilation

21 system and potentially impact the HEPA filters. There

22 are metal pre-filters. Staff is looking at the issue,

23 but the issue that the staff is looking at is the

24 metal pre-filters have a certain size -- I forget the

25 number -- .05 microns below which it would not filter

1 out. The staff is looking at whether it thinks the
2 size of the UO 2 particles could potentially go
3 through the metal pre-filters.
4 I would like to point out, as with all
5 these, we are discussing it with the applicant. I'll
6 point out that in this case there was an NRC
7 Information Notice 92-14 concern uranium oxide fires
8 at fuel cycle facilities.
9 Hydroxylamine nitrate/hydrazine, the item
10 is CS-2. This is another explosion event. The issue
11 here is that HAN is used with nitric acid to strip
12 plutonium from the solvent after the removal of the
13 americium and gallium. Hydrazine is used to impede
14 the reaction with the nitrous acid and, thus, increase
15 the HAN availability.
16 This is another issue of the HAN is
17 autocatalytic decomposition. There was an explosion
18 that occurred at Hanford in the 1990s. As a result,
19 DOE studied the phenomena. It developed what is known
20 as an Instability Index to link the various parameters
21 involved, such as chemical concentrations, molar ratio
22 of nitric acid to HAN, temperature, concentration of
23 metals, and pressure.
24 DCS has chosen not to use the Instability
25 Index because they feel that it doesn't accurately

1 represent their system, the reason being that they
2 don't think it adequately takes into account the
3 influence of plutonium. Instead, DCS has proposed a
4 model that they feel better reflects their system.
5 It's a series, I think, of five partial differential
6 equations that need to be solved.
7 So the staff is looking at that proposed
8 model. The staff is using commercial software
9 currently to test the DCS model. Staff has done some
10 runs of the DCS model. In some cases we were able to
11 replicate the results obtained by DCS.
12 However, in some cases we still have some
13 questions that we need to pursue about the model. I
14 don't think we fully understand it yet, and that's an
15 issue that we need to further discuss with DCS and
16 perhaps visit the DCS offices in Charlotte to get a
17 better hands-on feel for that model.
18 Another issue is the -- and this is really
19 four issues. It has to do with design bases for
20 hydrogen flammable gases. It has to do with the lower
21 flammability limit. The applicant has proposed using
22 a design basis of 50 percent for its lower
23 flammability limit. Staff thinks that 25 percent is
24 a better number.
25 It really comes down to an interpretation

1 of NFPA codes, NFPA 801 and NFPA 69. Staff has
2 interpreted it to mean certain things, and I think the
3 applicant has looked at it and I think they're
4 reaching different conclusions.
5 This is one where we haven't had the most
6 recent discussion with the applicant yet. We need to
7 meet with the applicant. They are going to document
8 their conclusions, and then I think we will follow it
9 up with a meeting with the applicant.
10 Emergency control room habitability,
11 CS-10, this is a matter of, what would be the proper
12 design bases for the emergency control room operators
13 in order such that they would be aware of certain
14 chemicals entering the control room and be don
15 protective gear?
16 DCS has proposed TEEL-3. I probably
17 should have talked about CS-5b first, but TEEL is a
18 Temporary Emergency Exposure Limit. I will talk about
19 that in a minute, but they have proposed TEEL-3s
20 initially.
21 They have subsequently discussed -- staff
22 has discussed the issue with the applicant. Staff
23 thinks that an IDLH value is perhaps a better one, an
24 Immediately Dangerous to Life and Health value. Where
25 the IDLH values are not available, DCS will rely on

1 TEEL-2 values. I think that the applicant has -- I
2 think we're very close to resolving this issue, based
3 on what I understand the applicant will be proposing.
4 The last issue is CS-5b. This has to do
5 with the TEELs, Temporary Emergency Exposure Limits.
6 TEELs were developed by the Department of Energy's
7 Subcommittee on Consequence Assessment and Protective
8 Actions. It was not done as part of the MOX Project.
9 The purpose was to serve as a temporary guidance until
10 the American Industrial Hygiene Association publishes
11 emergency response planning guideline concentrations
12 for various chemicals.
13 There's various TEEL levels: TEEL-0,
14 TEEL-1, TEEL-2, TEEL-3. They all have a qualitative
15 effect associated with them, such as mild transient
16 health effects or no irreversible serious health
17 effects, et cetera.
18 There are two concerns the staff have with
19 this. One is that TEELs are really not an NRC-
20 developed item or term. They were developed by a
21 committee of various DOE and DOE consultants from
22 across the complex and elsewhere.
23 But it's not cast in stone. Once you say
24 it, I mean it can be easily changed the next day,
25 actually, too. So that was one concern the staff had

1 with TEELs. That could be overcome by committing to
2 a value rather than a TEEL.
3 The other issue staff had concerns with
4 was the actual values proposed by DCS staff, thought
5 that these were, some of these were too high. So
6 where we are on this one is the staff has taken this
7 item. Staff recognizes that this issue is broader
8 than the MOX project. It has implications across
9 other fuel cycle facilities as well.
10 Staff has assigned this to a senior NRC
11 technical individual not associated with the MOX
12 project to look at this on a broader basis. It's our
13 action at this point.
14 What I have here is my concluding slide:
15 Where were we and where are we today? Back in April
16 of '02, we issued our draft Safety Evaluation Report.
17 We had approximately 56 open items. As you can see,
18 through the discussions, they actually went up a
19 little bit afterwards. The total went up, but at the
20 same time some of them were being worked off. So you
21 can see --
22 CHAIRMAN BONACA: But did they go up
23 because there were new items or because you went back
24 and --
25 MR. PERSINKO: I'm trying to recall now

1 why. They went up in the course of the discussion
2 with the applicant in trying to resolve certain
3 issues.
4 CHAIRMAN BONACA: Right.
5 MR. PERSINKO: But it's been level at 66
6 now since January of '03, and there's been a
7 progression to resolving the issues. There are
8 currently 12 open items, 10 of which are with DCS for
9 DCS action and two are with NRC.
10 Like I said, we plan to continue to dialog
11 with the applicant up to a point. We will continue to
12 dialog as long as we can and then some, but there's
13 going to be a point where we're going to have to say
14 -- I mean we'll continue to dialog, but if we don't
15 resolve it, we will be writing our Safety Evaluation
16 Report, and we still intend to issue a Safety
17 Evaluation Report in September right now, but it may
18 include open items in the FSER right now.
19 MEMBER POWERS: What's driving putting out
20 the Safety Evaluation Report in September?
21 MR. PERSINKO: It's a commitment we made
22 from day one, from a very long time ago, and I think
23 the staff feels an obligation to meet its schedule.
24 CHAIRMAN BONACA: Regarding issues such as
25 the Red Oil, for example, are you looking for insights

1 on what took place in the licensing of the French
2 facility?
3 MR. PERSINKO: We have contacted some of
4 the French facilities. We're also looking for what's
5 done at DOE. We're looking for that for insight,
6 though. I mean we are not using the French facility
7 to license this plant. We do look at information from
8 the French, as well as what's done at DOE.
9 MEMBER POWERS: Any other questions to
10 pose to Drew?
11 (No response.)
12 We have some challenges right now. My own
13 intention is to proceed along on the same imperative
14 that staff feels that they have. We have an
15 imperative to report back to the Commission. So we'll
16 be writing a letter to the Commission in association
17 with this SER wherever it stands, and we'll do it for
18 the September meeting.
19 CHAIRMAN BONACA: I would suggest that it
20 would probably be when the SER is issued.
21 MEMBER POWERS: Yes.
22 CHAIRMAN BONACA: Keep it on the open
23 items --
24 MEMBER POWERS: Yes, we'll have to write
25 to the Commission at that point and intend to do so.

1 My feeling is that I'm still very optimistic. I'm
2 naive and stupid. I say everything is going to get
3 resolved or resolved enough.
4 (Laughter.)
5 But, regardless, we'll write at that
6 point.
7 I think it is important to remember two
8 things in thinking about this facility. One is it is
9 governed by Part 70, which is governed by, contains a
10 rather different approach, and it is not our intention
11 in this letter to address the wisdom of that
12 regulation or any revision to that regulation, but,
13 rather, to speak to this facility as it stands
14 relative to that regulation.
15 The other thing to bear in mind is, as I
16 said earlier, we're doing one MOX facility. We don't
17 have on the books 5, 10, 15 of these. That may happen
18 in some future time, but not now. I'm not interested
19 in charting a new approach to the regulations of these
20 facilities and new approaches to criticality safety.
21 CHAIRMAN BONACA: Looking at the issue of
22 the open/closed system for Red Oil, if I remember, the
23 philosophy that you applied for explosions was, or the
24 applicant applied, was that they would focus on
25 prevention rather than mitigation. So you're looking

1 there for assuring that the event of an explosion is
2 low enough that you would be comfortable with it, and
3 they're pursuing the same path, but you're not
4 convinced that the process right now allows you to
5 reach that conclusion?
6 MR. PERSINKO: That's correct. We have
7 the same goal: to prevent it with adequate margin.
8 I think it's a matter of technical/professional
9 judgments on when is enough enough and what are the
10 right temperature values.
11 CHAIRMAN BONACA: Do you feel that it
12 depends too much on administrative guidelines? That's
13 another issue of --
14 MR. PERSINKO: Do you mean the Red Oil?
15 CHAIRMAN BONACA: Yes.
16 MR. PERSINKO: I'm going to defer that to
17 the chemistry folks.
18 MR. MURRAY: We're still trying to
19 complete analyses, if you will, a fault tree analyses
20 on the closed systems. One of the concerns in a
21 closed system is some of the admin.-type controls
22 cannot respond in enough time.
23 CHAIRMAN BONACA: So it's an issue of
24 defense in-depth in part, whether they rely on these
25 controls?

1 MR. KLOSKY: Mark Klosky, DCS.

2 I want to just follow up on that point.

3 I think you're correct in the statement that the

4 preventative strategy pertains to both systems, open

5 and closed. With respect to the administrative

6 controls, our controls on the steam temperature are

7 engineered controls and do not rely administrative

8 features.

9 CHAIRMAN BONACA: Okay, thank you. That's

10 good clarification.

11 MEMBER POWERS: Well, in addition, you

12 have purity control/temperature control, and now we're

13 discussing venting controls.

14 MR. KLOSKY: Right.

15 MEMBER POWERS: Now these are all pretty

16 much design and operation issues.

17 CHAIRMAN BONACA: Right, yes.

18 MEMBER POWERS: Any additional comments,

19 Drew?

20 MR. PERSINKO: No, I don't think so. I

21 mean, I guess I like -- the regulation was written, it

22 is a fairly recent regulation, within the last few

23 years. The Commission, during the Part 70 regulation

24 rulemaking proceeding, was very clear to the staff

25 that a quantitative analysis was not required. So, I

1 mean, that's clear by the Commission. So we have this
2 regulation which sort of has a quantitative, you might
3 think a quantitative underpinning, but, yet, it does
4 not require that there has to be quantitative analysis
5 performed.
6 MEMBER POWERS: In addressing this issue,
7 I'm not willing to take that -- advise the Commission
8 on the wisdom or lack of wisdom of their decisions on
9 that. We may want to do that but separately from
10 this. I mean we want to stay within what the
11 constraints are here. I mean that has always been the
12 purpose.
13 Subsequently, we will be looking at the
14 ISA on this at some point. One can imagine at some
15 point we'll be looking at the ISA. Again, I'm not
16 interested in taking on the issue of whether ISA or
17 PRA is the appropriate thing in connection with the
18 facility, but we may want to take that issue on and
19 advise the Commission separately.
20 CHAIRMAN BONACA: Although, I mean, this
21 is a facility which is quite different from a nuclear
22 reactor. It's, in fact, a series of shells, of areas,
23 and so on and so forth, and it even lends itself
24 better to this approach than we would have on the
25 normal reactor, I think.

1 MEMBER KRESS: Our sister Committee, ACNW,
2 took that issue up and advised the Commission that the
3 ISA is a good way to go at this time, but eventually
4 they might want to think about going to full PRA, as
5 best I remember their advice.
6 MEMBER POWERS: That's exactly right.
7 I'm, again, not interested in taking that issue on.
8 I think we work within the constraints of regulation
9 in connection with this facility.
10 I simply comment that, by and large, the
11 chemical industry has not gravitated toward the kind
12 of PRA that we are looking at, and I have to believe
13 that you have to give some credence to the fact that
14 they have elected not to do that. I mean you have to
15 understand you can't automatically assume that we
16 should. This ISA approach looks attractive.
17 MR. PERSINKO: I think when you do a PRA
18 is also a function of the hazard or the risk of the
19 facility. That has to be taken into account, too.
20 I think, as was sort of alluded to
21 earlier, I look at a reactor as a close-coupled
22 system. What I mean by that is an event occurs and a
23 whole series of events happen right after that.
24 Automatically, a lot of things happen.
25 In a materials facility, it's more

1 distributed throughout the plant and things can happen
2 at different points. It's not like you're trying to
3 prevent one thing like, say, a core melt. So I think
4 it's a different type of animal.
5 MEMBER ROSEN: Can I get away from the
6 philosophy questions for a moment and just talk about
7 closure of this open-versus-closed, this closed system
8 discussion?
9 I continue to be mechanistically
10 interested in how that's resolved. I presume that we
11 will follow this as we go forward?
12 MEMBER POWERS: Count on it.
13 (Laughter.)
14 Thanks, Drew, and thank you, people from
15 DCS. Your comments were valuable to us, and good luck
16 on your work to resolve all these issues.
17 I'll turn it back to you, Mr. Chairman.
18 CHAIRMAN BONACA: Okay. With that, we
19 will take a break now until five after 11:00.
20 (Whereupon, the foregoing matter went off
21 the record at 10:50 a.m. and went back on the record
22 at 11:07 a.m.)
23 CHAIRMAN BONACA: Let's get back to the
24 meeting and the next item on the agenda is proposed
25 criteria for treatment of individual requirements in

1 regulatory analysis, and Dr. Kress will take us
2 through this presentation.
3 MEMBER KRESS: The title is a little bit
4 cryptic. What this is about is when the staff has to
5 do a regulatory analysis to see if some regulation can
6 be put into place that causes the requirements to be
7 put on a licensee.
8 The regulatory analysis calls for cost
9 benefit and the analysis cost benefit criteria, and it
10 is possible when you put together a rule that the rule
11 could have several requirements in it. And now all
12 the requirements may be fully necessary that the rule
13 is meant to solve, and in fact some of the
14 requirements may be just supportive of the whole rule.
15 Now the question is for such a possibility that you
16 may end up if you bundle all of these requirements
17 together in one requirement the whole system may be
18 able to pass the cost benefit criteria.
19 But one or more of these parts may by
20 themselves fail a cost benefit if you just used it as
21 a separate requirement. So the question is how do you
22 deal with that situation, and how do you prevent just
23 sticking in requirements in a bundled thing that
24 overall meets the cost benefit.
25 But we may have some in there that should

1 not be in there. So the staff has developed a way to
2 deal with this, and that is what this is all about.
3 CHAIRMAN BONACA: Well, the hydrogen rule
4 was a catalyst behind --
5 MEMBER KRESS: Yeah, the hydrogen was,
6 because there was several parts to it, like whether to
7 keep the fans powered, as well as the igniters, and so
8 that I think was the catalyst.
9 CHAIRMAN BONACA: So we may want to keep
10 that in mind as we go to the presentation, and it will
11 help us understand.
12 MEMBER KRESS: Right. Okay. With that,
13 I will turn it over to whoever.
14 MR. RICHTER: Thanks, Dr. Kress. I am
15 Brian Richter, in NRR, and as Dr. Kress mentioned, we
16 are here to discuss bundling, what it is, the concerns
17 that it has raised, what the staff has done in
18 response to these concerns, what cementers have said
19 about what has been done, what the Commission has
20 done, and finally what the staff is proposing to do in
21 the future on this.
22 The objective for us being here today is,
23 and at your invitation, of course, and we are
24 interested in getting your consent on the approach
25 that we are proposing on the bundling issue.

1 Given that this guidance we are proposing
2 is better than the existing guidance and addresses
3 issues that have not been raised before, we are hoping
4 that contained consent would allow us to get quicker
5 use by the staff in the regulatory analyses.
6 However, if the staff is able to obtain
7 comments to improve the approach, and if needed to
8 obtain additional information, it could be inserted in
9 a new revision that would be coming down the road to
10 the Guidelines 0058, which would be Revision 5.
11 Right now, of course, Revision 3 is out
12 there and what we are hoping to do is include some of
13 these approaches in Revision 4.
14 MEMBER KRESS: What is this -- have you
15 released this proposal to public comment?
16 MR. RICHTER: Yes, correct.
17 MR. SNODDERLY: Excuse me, Brian. Brian,
18 this is Mike Snodderly. Is it true that -- and as
19 stated in the Federal Register notice, that the public
20 comment period ended July 2nd?
21 MR. RICHTER: That's correct.
22 MR. SNODDERLY: Okay. Could you also give
23 the committee some idea of the number of comments you
24 received and the schedule that you think it will take
25 to resolve those?

1 MR. RICHTER: So far we have received one
2 comment that, and that was from NEI, and I will go
3 into that in the slides. Dr. Kress basically
4 explained the issue that we are dealing with.
5 The background also was mentioned dealing
6 with combustible gas control. There were three
7 actions in correspondence, in SECY papers, and SRMs,
8 that related to the bundling issue.
9 The combustible gas control 50-44 was one,
10 and in the SRM that came down on that one the
11 Commission agreed with the staff's recommendations,
12 but they challenged the staff to establish a process
13 solution.
14 MEMBER WALLIS: So we are dealing with a
15 process here in this discussion?
16 MR. RICHTER: Well, in the regulatory
17 analysis process. The second item of course was
18 fitness for duty, and that was one another one that
19 got -- that was controversial, and the industry came
20 in expressing concerns.
21 The staff suggested that the OMB package
22 be rescinded and the Commission agreed to that, and
23 the SRM that the Commission came down with directed
24 the staff to ensure that the individual rule changes
25 are integral to the purpose of the rule, and cost

1 justified or qualified as back fit exceptions.

2 And then with SECY 01-0162. again with

3 50.44, and the SRM that came down on that, the

4 Commission agreed with the staff's proposal and

5 directed the staff to implement a disciplined,

6 meaningful, and scrutable methodology for evaluating

7 the value impact of any new requirements that could be

8 added by a risk-informed alternative rule.

9 MEMBER KRESS: Let me ask you a question

10 about that.

11 MR. RICHTER: Sure.

12 MEMBER KRESS: As I recall in the

13 combustible gas problem that they did sort of a

14 sensitivity uncertainly analysis, and it was more of

15 a sensitivity, but they had -- when you took the high

16 end of the sensitivities, and the low ends of the

17 sensitivities, and did subtractions of the costs and

18 benefits on those, that it was indeterminate, in the

19 sense that you crossed over the line.

20 Now, how do you plan -- suppose that

21 happens again in some other back fit. Have you got a

22 way to deal with that issue now, or is that part of

23 the guidelines that you are going to put together?

24 MR. RICHTER: I think basically the idea

25 for the Reg analysis is always meant to be as a tool

1 for the decision makers at the Commission, and to
2 provide them with that information I think is very
3 helpful for them to have to decide which way they want
4 to go with any given action then.
5 MEMBER KRESS: But when you have it in
6 these places where it is hard to decide what to do
7 because the ranges of the sensitivity are such that
8 you really have on both sides of the thing is that
9 there is no way to provide some guidance on what to
10 do, or is that just left up to the judgment of the --
11 MR. RICHTER: Correct. I think you show
12 the best estimate, but then you show what occurs with
13 the ranges and it is up to the Commission then to
14 decide. I mean, the staff might make a
15 recommendation, but it is the Commission's final
16 choice.
17 MR. GILLESPIE: Brian, Frank Gillespie.
18 I am going to add a complication into the example,
19 because I am the only one that raised my hand on
20 50.44, because it gets to some of the other proposals,
21 and it was wasn't just stretching the limits if you
22 will in the gray area.
23 There are also two completely different
24 phenomenological questions which were discreetly
25 separable. There was igniters which were generally

1 focused on early containment failure, and then there
2 was recombiners which were focused on late containment
3 failure.
4 And then mixed, because it was all the
5 hydrogen rule that had a phenomenological cost overlap
6 and used the cost overlap to try to justify the
7 igniters, because if you didn't have the recombiners,
8 you would save so much.
9 So I think the separability of the
10 technical issue is also in question here. It is not
11 just the cost part of it, and I think that is
12 important I think for where Brian is going with this.
13 Does that sound familiar?
14 MEMBER KRESS: Yes.
15 MR. GILLESPIE: I think we had that
16 discussion. Do you remember that?
17 MEMBER KRESS: Yes, I remember it.
18 MEMBER LEITCH: Can you help me with the
19 document that we are dealing with here, the regulatory
20 analysis? Is that -- I have not heard that term. Is
21 that a document?
22 MEMBER KRESS: Yes, it is a back-fit
23 document. This guideline, this regulatory analysis
24 guidelines, the NUREG, that is an extremely
25 interesting report to read, and each one of us ought

1 to get a copy of it and read it.

2 It tells us how to do these back-fits, and

3 it is very well done I think. It is well worth

4 reading.

5 MEMBER LEITCH: And that is the document

6 that

7 we are relying on here?

8 MEMBER KRESS: Yes. Well, it is the

9 guidance that they are modifying.

10 MR. MIZU: This is Gary Mizu in the Office

11 of the General Counsel. I just wanted to add a little

12 bit to that. We have back-fitting guidance and we

13 also have the regulatory analysis guidance, which is

14 what we are talking about here.

15 And although there is an overlap, there

16 are aspects of backfitting which are not covered by

17 the regulatory analysis guidelines. And just to give

18 you a little bit of history why these regulatory

19 analysis guidelines exist, it is because early on in

20 the Reagan administration the President issues an

21 executive order directing Executive Agencies to do

22 regulatory analyses.

23 And even though that executive order

24 didn't bind an independent commission like the NRC,

25 the Commission voluntarily agreed to do regulatory

1 analyses. And I think in the late 1990s, Congress
2 passed a law which actually made regulatory analyses
3 binding upon all components of the Federal Government,
4 including the NRC.
5 So now we are required to do these
6 regulatory analyses, and so our guidelines are
7 intended to -- I mean, they are part of this
8 continuing effort to allow agencies to analyze
9 potential activities and determine whether they make
10 sense.
11 I mean, that is what we are fundamentally
12 trying to do here. These guidelines are to help an
13 agency understand whether proposed actions, whether
14 they be rule making or the issuance of orders, or
15 whatever it may be, whether it makes sense. Are the
16 benefits justified and are the costs justified.
17 MEMBER WALLIS: Well, I was going to say
18 that I am glad that Frank spoke up, because we don't
19 usually get involved with the regulatory process per
20 se, but he says that it is an issue of separability of
21 mechanical issues, and if the mechanical issues are
22 tangled up, then there seems to be something that the
23 ACRS should be concerned with.
24 MEMBER KRESS: Well, we used to. They are
25 always dealing with some safety issue.

1 MEMBER WALLIS: Well, if it is just some
2 kind of bureaucratic process, we don't usually get
3 involved.
4 MEMBER KRESS: Yes, but we do get involved
5 in regulatory analysis, because that is sort of --
6 MEMBER WALLIS: Because the technical
7 issues have to be sort of weighed, in terms of
8 economics, and reasonableness.
9 MEMBER KRESS: Well, when we get involved
10 with any kind of rule making in there, and that is
11 always associated with rule making.
12 MR. RICHTER: This slide goes over quickly
13 the activities that the staff has undertaken so far
14 basically for the formation of a working group. We
15 had a preliminary policy published for comment and
16 called for an open meeting. That meeting was held and
17 we revised our approach based on comments received,
18 and --
19 MEMBER WALLIS: Were these comments from
20 industry?
21 MR. RICHTER: Correct.
22 MEMBER WALLIS: A typical public meeting
23 in other words?
24 MR. RICHTER: Exactly, yes. You have been
25 there? We went before the CRGR and received their

1 endorsement, and received approval from the Commission
2 to go forward with it, and that was published.
3 It went out for public comment and it was
4 mentioned in April, and we got one comment on the due
5 date from -- or one letter from NEI on that date, and
6 that is all that we are aware of having received so
7 far.
8 These are the criteria as they were
9 published on the most recent FRN on that. First, if
10 an individual requirement is necessary, and that is
11 needed in order to the objectives of the rule, and
12 contain consistency with Commission policies, it does
13 not need to be analyzed separately. In other words,
14 you could bundle it.
15 MEMBER KRESS: And how do you decide on
16 whether something is necessary or not? Do you have
17 some criteria?
18 MR. RICHTER: We went over -- let me try
19 to find the exact words.
20 (Pause.)
21 MR. RICHTER: The NRC maintains that if an
22 individual requirement is integral to the purpose of
23 the rule, then that fact alone is a sufficient basis
24 for its conclusion. And in fact a decision on its
25 inclusion or exclusion is not discretionary.

1 However, if the NRC finds that if a
2 requirement is not deemed integral, it should be
3 included if it is -- oops, I am going ahead into some
4 else. But basically it is judgment based on whether
5 it is integral and necessary, or whatever, and words
6 that one feels more comfortable with.
7 I think that there is mostly agreement,
8 except in the example that Frank brought up, and which
9 was a technical difference really. But we hope
10 spelling this out covers that issue.
11 MEMBER LEITCH: If I understand then to
12 pursue Frank's hydrogen example, since the igniters
13 and the recombiners deal with separate phenomena, at
14 least phenomena that occur at different times, we are
15 saying that they should be stand alone analysis to
16 justify those?
17 MR. RICHTER: Correct.
18 MEMBER LEITCH: Okay.
19 CHAIRMAN BONACA: So in the case of the
20 rule, if it had been shown that you needed monitoring
21 of the hydrogen as a fundamental element of the rule,
22 then you would not have to analyze its value
23 separately?
24 MR. RICHTER: Right.
25 CHAIRMAN BONACA: And in the rule itself

1 we found that it wasn't justified. But that is really
2 the criteria that you are using?
3 MR. RICHTER: Yes.
4 MEMBER WALLIS: So this second part here
5 really is equivalent to saying that this individual
6 requirement is cost beneficial per se within the
7 context of the whole thing.
8 MEMBER KRESS: Yes, it has to be cost
9 beneficial by itself is what they said.
10 MEMBER WALLIS: So this is a roundabout
11 way of saying it, is that it adds cost benefit to the
12 whole bundle.
13 MEMBER KRESS: Yes, but that is what it
14 means, that it has to be cost beneficial by itself.
15 MEMBER WALLIS: All right. Now, more cost
16 beneficial is simply in terms of plus and minus cost
17 and benefit, and it is not a question of ratios or
18 anything?
19 MEMBER KRESS: No. That was the debate
20 that we had a long time ago, of whether using ratio or
21 the difference, and they came down on using the
22 difference.
23 MR. RICHTER: And hat is OMB guidance as
24 well.
25 MEMBER KRESS: Yes.

1 MR. RICHTER: I mean, you can use the
2 ratio of on a --
3 MEMBER KRESS: Yes, that is sort of
4 additional information.
5 MR. RICHTER: Yes.
6 MEMBER KRESS: And then when we talk about
7 cost benefit here, we are talking about the
8 difference.
9 MEMBER WALLIS: That is clear?
10 MEMBER KRESS: It is pretty clear in the
11 guidance.
12 MR. RICHTER: The next bullet on Slide
13 Number 10, if an individual requirement is unrelated
14 to the overall regulatory action, and it should be
15 included only if it makes the bundle requirements more
16 cost beneficial, and it passes the back-fit test, if
17 applicable.
18 CHAIRMAN BONACA: By itself, or bundled?
19 MR. RICHTER: By itself.
20 CHAIRMAN BONACA: By itself. So you have
21 to then --
22 MEMBER KRESS: Well, you have to almost
23 analyze these things separately anyway.
24 CHAIRMAN BONACA: You're right.
25 MR. RICHTER: This aggregation is only

1 appropriate if it produces substantively different
2 result alternatives with potentially meaningful
3 implications on the cost benefit results.
4 And while this -- and while not directly,
5 but it is sot of the same guidance that we are looking
6 at in terms of uncertainty, and to point out to where
7 the Commission or the decision makers, where this line
8 might be where on one side it was cost beneficial and
9 the other isn't.
10 If an individual requirement in a
11 voluntary rule is justifiable under back-fit criteria,
12 the NRC should consider imposing this as a mandatory
13 back-fit.
14 MEMBER WALLIS: I am not quite sure about
15 this produces substantially different alternatives.
16 Does that mean that you get more possible tanical ways
17 of resolving whatever the question is?
18 MR. RICHTER: I'm sorry, what --
19 MEMBER WALLIS: The second bullet, the
20 substantially different alternatives, this aggregation
21 per say doesn't produce does it? It allows them
22 consideration.
23 MR. RICHTER: I think in terms of the
24 analysis, the results.
25 MEMBER WALLIS: Then it permits. This

1 aggregation then permits alternatives. It does not by
2 itself produce anything.
3 MR. RICHTER: Yes, I see your point. Yes.
4 MEMBER WALLIS: So it allows more
5 flexibility.
6 MEMBER SHACK: What does this aggregation
7 cover that isn't in the first three criteria? I mean,
8 the first criteria covers all requirements that are
9 necessary, and the next one covers those that are
10 supportive, and the third one covers those that are
11 unrelated. What am I going to disintegrate to a
12 different scale than that?
13 MEMBER KRESS: Good question.
14 MEMBER WALLIS: Maybe it is a
15 reaffirmation of the first three.
16 MR. RICHTER: I guess the emphasis there
17 would be on --
18 MEMBER KRESS: On alternatives.
19 MR. RICHTER: Yes, substantively different
20 alternatives.
21 MEMBER SHACK: Well, if something is
22 absolutely necessary, then maybe it isn't dependent,
23 but I just have a hard time seeing where I would use
24 it, versus the first three. The first three I can
25 understand.

1 MR. RICHTER: I don't remember way back
2 when as to how this particular bullet was derived, but
3 at least we are consistent.
4 MEMBER SHACK: Redundancy is a major NRC
5 flaw.
6 MR. RICHTER: And lastly mandatory back-
7 fit. As I mentioned, NEI were the only cementers that
8 we are aware of so far, and it is has been a little
9 over a week now. And their comments were similar or
10 identical with the comments received on the
11 preliminary proposal criteria, and those were the ones
12 published before the public meeting.
13 NEI stated that they did not feel that
14 their comments had been addressed in preparing the
15 proposed criteria. Basically their concerns are that
16 they feel that the criteria is necessary to evaluate
17 the bundling of individual requirements into a single
18 regulatory analysis.
19 And that the distinction on risk informed
20 voluntarial alternatives should be cost justified and
21 integral or necessary, and not cost justified or
22 integral, which is what the staff had been proposing.
23 And in the second bullet, they claim there
24 is a lack of scrutinable guidance by the NRC. And
25 related to that is saying there is too much use for

1 objective judgment in making bundling decisions, and
2 we are requesting another public meeting on the issue.
3 MEMBER KRESS: So you have not resolved
4 these.
5 MR. RICHTER: We think we did, but not to
6 their satisfaction.
7 MEMBER KRESS: I see.
8 CHAIRMAN BONACA: Could you go back a
9 moment. On the first bullet or sub-bullet --
10 MR. RICHTER: Which is that? I'm sorry.
11 CHAIRMAN BONACA: Well, the one that says
12 not cost justified or integral.
13 MR. RICHTER: Okay.
14 CHAIRMAN BONACA: I mean, I don't
15 understand when integral would not be cost justified.
16 I guess I don't understand. I thought the integral
17 here in this context meant necessary.
18 MR. RICHTER: Yes.
19 CHAIRMAN BONACA: And by necessary, you
20 have already provided the definition which said that
21 it was cost beneficial. Oh, no, I see. I see. It
22 says necessary, meaning that the objective of the
23 rule, and it does not require a test of cost
24 effectiveness.
25 MR. RICHTER: Correct.

1 MR. GILLESPIE: Let me give you an
2 example, 50-69. The industry might say that if you
3 separate out the need for a quality PRA that that in
4 and of itself, that the cost of that is not justified
5 necessarily if you separate it.
6 But the staff used a quality PRA as being
7 integral to being able to meet the mission of the
8 rule. Now, that is kind of an extreme example and it
9 is not that we are fighting with --
10 MEMBER KRESS: That is a good one though.
11 MR. GILLESPIE: -- NEI on that, but that
12 is the rule that is a cost beneficial alternative rule
13 that is risk-informed, and the quality of PRA is a
14 point that they are making. They are pushing too high
15 for a high quality PRA. There is costs involved.
16 And it is not integral to the purpose, and
17 we are saying that it is integral to the purpose of
18 the rule. And that is where you get to the end of the
19 order.
20 MEMBER WALLIS: I would be inclined to
21 support you folks.
22 MR. RICHTER: Great.
23 MEMBER KRESS: And what do they mean by
24 this lack scrutable guidance thing? It seemed pretty
25 scrutable tome. What guidance were they talking

1 about?

2 MR. RICHTER: The proposed guidance in the

3 Federal Register notice.

4 MEMBER KRESS: I see.

5 CHAIRMAN BONACA: But the cost benefit

6 approach is still the same, and it has not changed.

7 MEMBER KRESS: Oh, no, that has not

8 changed.

9 MR. RICHTER: And at some point it does

10 involve the judgment and the staff's position is that

11 if one tries to spell out every possibility as to when

12 to do this or that --

13 MEMBER KRESS: If things come down clearly

14 to cost benefits, you won't have a problem.

15 MR. RICHTER: That's right.

16 MEMBER KRESS: It is when you are getting

17 close to the border of the criteria, and the

18 uncertainties are pretty large, they become murky

19 then, and that may be where the --

20 MR. RICHTER: But our position is that as

21 long as that is spelled out in the analysis to give

22 the decision maker the opportunity --

23 MEMBER KRESS: The decision makers know

24 what they are dealing with if you tell them what that

25 is.

1 MR. RICHTER: Correct.

2 MEMBER KRESS: Okay.

3 MR. RICHTER: So the working group --
4 unfortunately, most of the working group is on leave
5 right now, but as soon as we come back, we will get
6 together and try to resolve the comments. Then
7 present what we have agreed with to management, and
8 see if management agrees that another public meeting
9 is worth it or not.

10 Hopefully then we can draft the revised
11 guidelines input, and submit it to the Commission.
12 The revision will also include additional information
13 on the handling of uncertainties. Ashok Thadani wrote
14 to Bill Travers on October 1st of 2002 on the, quote,
15 revision to NRC's regulatory analysis guidelines in
16 RES Office Letter 1, to conform to OMB's information
17 quality guidelines.

18 In it, Research wanted to the Reg analysis
19 guidance to more closely conform to the treatment of
20 uncertainties as prescribed in OMB's information
21 quality guidelines.

22 There was an attachment to that which
23 contained Research's review and recommended revisions,
24 which are consistent with the general discussion of
25 COM SECY-02-0037, which was approved by the Commission

1 on July 31st, 2002.

2 MEMBER SHACK: What was that SECY?

3 MR. RICHTER: It was a COM SECY-02-0037,

4 July 31st of 2002.

5 MEMBER KRESS: I am interpreting the fact

6 that these are the only comments that you got back to

7 mean that the industry in general is not too unhappy

8 with.

9 MR. RICHTER: I would like to interpret it

10 that way.

11 MEMBER KRESS: Usually when they are not

12 too pleased, you get lots of comments from --

13 MR. GILLESPIE: Yes, I think you are

14 right. I think that these comments reflect the

15 ongoing discussion about quality PRA and risk informed

16 alternatives, and the cost of doing a high quality

17 complete PRA, versus the alternative.

18 And the other one is a residual one from

19 the first example, which was the fitness for duty

20 rule. The drug testing case and the quality of drug

21 testing was separable from some of the other issues in

22 it.

23 And they are still reeling from that, but

24 I don't think you could set up guidelines that would

25 identify, and other than highlight, you should look

1 for that.

2 And also this idea that you have got two

3 different phenomenological effects on hydrogen control

4 that we ended up looking at. Well, not that we are

5 kind of consciously aware of it, I think that is

6 probably the best that we can do, which means that I

7 a not sure that another meeting is going to solve

8 these questions.

9 MEMBER KRESS: It doesn't seem like

10 another meeting would.

11 MR. GILLESPIE: I am leading a little bit

12 there.

13 CHAIRMAN BONACA: The first bullet from

14 NEI really refers only to the fifth criterion that you

15 had provided. I mean, that is the one on voluntary

16 alternatives.

17 MEMBER SHACK: No, I think it really goes

18 to the second one.

19 MEMBER KRESS: Yes, it goes to the second

20 one.

21 MEMBER SHACK: Where it is supportive.

22 MR. RICHTER: Yes, very much so.

23 CHAIRMAN BONACA: But it speaks of risk-

24 informed voluntary initiatives.

25 MEMBER KRESS: I know that.

1 CHAIRMAN BONACA: And if you look at the
2 fifth criterion, it requires a voluntary rule.
3 MEMBER SHACK: You see, they only want you
4 to have an interval.
5 MR. GILLESPIE: Right.
6 CHAIRMAN BONACA: But I wonder if it is
7 again applicable to the fifth criterion or the first
8 one.
9 MEMBER KRESS: Or the second.
10 CHAIRMAN BONACA: Or the second.
11 MR. MIZU: The thing about that first sub-
12 bullet, where they talk about risk-informed voluntary
13 alternatives, judging from what NEI had previously
14 argued in the 50-69 meetings, it is not so much that
15 they are concerned about it being risk informed.
16 They are concerned about it bering a voluntary
17 alternative.
18 CHAIRMAN BONACA: Voluntary.
19 MR. MIZU: And the reason why is because
20 the way that the Commission or the way that the staff
21 has previously evaluated both from a back-fitting
22 standpoint and from a regulatory analysis standpoint
23 a voluntary alternative, is that you are not required
24 to do it. You make your own judgment whether it makes
25 sense to you from a technical and a cost beneficial

1 standpoint for you to implement this alternative.

2 And the industry is coming back and

3 saying, well, look, you are going to waste a lot of

4 time and you are going to waste our time, and no one

5 is going to use an alternative that you develop if you

6 in fact -- even if it was voluntary, presumably you

7 are developing it because you think you want people to

8 use it.

9 But no one is going to use it if it in

10 fact contains non-cost justifiable provisions, which

11 I think on its face seems reasonable, and I guess that

12 part of the analysis that we are trying to do here

13 would in fact take into account those kinds of

14 considerations, but not necessarily in the way that

15 the industry wants us to do the evaluation.

16 I mean, we understand that you develop an

17 alternative which pulls this inordinate cost, and

18 contains minimal benefits. No one is going to use it

19 and the Commission's regulatory objective is not going

20 to be achieved.

21 But if no one is going to use this 50-69,

22 then what is the whole purpose of wasting 5 years and

23 multi-million dollars worth of staff FTEs to develop

24 this alternative.

25 And we understand that. The problem is

1 that I think they are fixed to ensure that we have a
2 good cost beneficial alternative would probably not be
3 a good approach of doing it, and we think that this is
4 a better approach.
5 MEMBER KRESS: Well, when I look at that,
6 I see, well, you are not going to have a voluntary
7 alternative in your set of alternatives unless it is
8 first all integral, and if this is all parts of an
9 integral, because you have already said that you are
10 not going to have a necessary integral.
11 You also are not going to have it in there
12 as an alternative unless it is cost justified on the
13 whole. So I don't understand -- I really don't
14 understand their comment.
15 MR. RICHTER: Our response in the FRN
16 reads that they NRC maintains that if an individual
17 requirement is integral to the purpose of the rule,
18 then that fact alone is a sufficient basis for its
19 inclusion.
20 MEMBER KRESS: Yes.
21 MR. RICHTER: And in fact a decision on
22 its inclusion or exclusion is not discretionary.
23 However, the NRC finds that if a requirement is not
24 deemed integral, it should be included if it is cost
25 justified. This alone is a sufficient basis, because

1 cost benefit methodology directs one to select the
2 alternative with the largest net benefit.
3 MEMBER KRESS: Sure.
4 MR. RICHTER: This is clearly stated in
5 OMB guidance, and guidance contained elsewhere in
6 NRC's Regu analysis guidelines.
7 MEMBER KRESS: Yes, I think that is a good
8 reply. The only problem I might have with it is
9 deciding whether something is critical or necessary,
10 and that takes that judgment. I mean, there is not a
11 clear cut thing, but you have always got to deal with
12 that.
13 MEMBER WALLIS: But that is what they are
14 after isn't it, is this Criterion 1, which is that by
15 requiring something that isn't necessary, you can get
16 away from cost benefit.
17 MEMBER KRESS: Yes.
18 MEMBER WALLIS: And they are worried about
19 that, because the agency will how say, well, all these
20 things are necessary.
21 MEMBER KRESS: Well, you don't get away
22 from the cost benefit. You just -- you have to
23 remember that this is bundling.
24 MEMBER WALLIS: IT's bundling, and you
25 just don't do it separately.

1 MEMBER KRESS: Yes. But there is another
2 part of it, which says that the regulatory analysis --
3 MEMBER WALLIS: So you don't et away from
4 cost benefit.
5 MR. MIZU: You don't get away from it, but
6 I think to understand what the industry is talking
7 about, and how this bundling can hide things, let's
8 suppose you have an element which is integral, okay,
9 but it is very close to the line, okay?
10 The costs are relatively high and the
11 benefits are perhaps just a little bit higher than
12 that, okay? And then you have another benefit which
13 is not integral, but cost beneficial. But this cost
14 beneficial element is very high. I mean, you have a
15 very low cost, and very great benefit.
16 And you throw it into the mix. So you
17 have these two things, and that when you do the
18 overall aggregated analysis, you are going to show a
19 very big benefit, and that very big benefit is sort of
20 swamping or obscuring if you will the fact that the
21 integral method is kind of close.
22 And that is what the entry is saying. You
23 need to be aware of that, and that is where the --
24 when we talk about the judgment of the reviewer to say
25 perhaps this is a situation where this aggregation is

1 necessary to present the true nature of what is
2 happening.
3 MEMBER KRESS: And that goes to this
4 aggregation wouldn't it?
5 MR. MIZU: Yes, and in that case, this
6 aggregation would likely be a better thing to do.
7 MEMBER KRESS: But this aggregation means
8 that you identify separate components and count them
9 as one?
10 MR. MIZU: Right. And NEI complained that
11 the -- that we didn't provide them sufficient guidance
12 or we did not provide the NRC sufficient review so
13 that that process of deciding when to disaggregate is
14 "scrutable."
15 Well, I just gave you an example. How do
16 you write down judgment in a way that would allow the
17 NRC reviewer to take into account all of the potential
18 different ways that these different requirements could
19 be bundled together.
20 MEMBER KRESS: Well, we just have to fess
21 up that you can't get judgment completely out of it.
22 You have to got to rely on your good judgment.
23 MR. MIZU: Exactly.
24 CHAIRMAN BONACA: But it seems to me also
25 that the fact itself that now in the benefit analysis

1 that you have to disaggregate and evaluate both sides
2 good, and so why not. I mean, the analysis become
3 much more clearer than it was before.
4 I mean, that already answers the concerns
5 of NEI.
6 MEMBER KRESS: And you generally do this
7 aggregation anyway when you are doing the cost
8 benefit, because that is the way you decide on the
9 different policy efforts, and so it generally shows
10 up.
11 CHAIRMAN BONACA: That's right.
12 MEMBER KRESS: Are there any comments or
13 questions?
14 MEMBER SHACK: Doesn't Bullet 2 still
15 slightly scrape the back-fit rule? The back-fit rule
16 says that you not only have to have a cost beneficial
17 thing, but you have to have a substantial --
18 MEMBER KRESS: Oh, that is still in there.
19 MEMBER SHACK: Well, doesn't Bullet 2 get
20 you
21 -- doesn't it sort of scrap that substantial part?
22 MEMBER KRESS: No, I think that would
23 still be there.
24 CHAIRMAN BONACA: Okay.
25 MEMBER KRESS: Which page are you on?

1 MEMBER SHACK: Page 9.

2 CHAIRMAN BONACA: Page 9, the second

3 bullet.

4 MR. MIZU: You have to remember that not

5 everything is redacted and so you may have situations

6 where -- I mean, you assumption is that every new

7 requirement has a back-fit, and that is not necessary

8 true.

9 For example, 50-69 would in fact not be a

10 back-fit.

11 MEMBER KRESS: That's right. Any other

12 comments or questions?

13 MEMBER WALLIS: What do we have to do,

14 Tom, about this?

15 MEMBER KRESS: Well, I was struggling with

16 this, and they would like a letter, particularly if we

17 think that this is a good fix or a good set of

18 guidance, and I am considering having such a letter.

19 I think that this addresses the issue that was brought

20 up by the Commission and it addresses it in a pretty

21 good way, and I can think of no other way to do it

22 actually.

23 So I am thinking about just a simple

24 letter that --

25 MEMBER WALLIS: A simple letter?

1 MEMBER KRESS: Yes, that says something
2 like that. But we can talk about it when we get to
3 the letter writing session.
4 CHAIRMAN BONACA: Okay.
5 MEMBER WALLIS: I think it should be
6 simple, and should not get embroiled in all sorts of
7 legalistic --
8 MEMBER KRESS: Right, I don't want to do
9 that.
10 MEMBER SHACK: That is a cost benefit
11 itself, and I think you would love to weigh in on
12 this.
13 MEMBER KRESS: Yes, that is one of your
14 themes throughout here.
15 MEMBER WALLIS: All rules of cost benefit,
16 all regulations based on cost benefit?
17 MEMBER LEITCH: I really have sort of an
18 unrelated question, but the other side of the coin
19 really. Let's say that industry -- I guess it is
20 really related to risk.
21 Let's say that industry comes in with a
22 change that they want to make in a plant that has
23 several different components to it. One of them
24 increases the risk, but several others are included,
25 and perhaps my example unrelated, that decrease the

1 risk. So that the net reduction is a very small
2 change in risk.
3 MEMBER KRESS: That is a very interesting
4 observation because that relates to 1.174.
5 MEMBER LEITCH: Yes.
6 MEMBER KRESS: And how you deal with
7 bundling there.
8 MEMBER LEITCH: Yes.
9 MEMBER KRESS: And I think that is a good
10 question.
11 MEMBER LEITCH: And I don't have any --
12 you know, does this raise the issue of do we need to
13 clarify what our position is in that matter, or is it
14 already clear? I'm not sure.
15 MEMBER KRESS: I think that issue has been
16 before the staff and I am not sure if they have come
17 up with any guidance or not.
18 MR. GILLESPIE: I have been involved with
19 meetings that have wrestled with the question, but I
20 have never been involved in a meeting that wrestled
21 with the answer.
22 So I think that is a good point. That
23 causes us then to jump into discussions to defense in
24 depth and saying that I am changing my initiating
25 frequencies, and so I am giving up mitigation, and at

1 that point the discussions usually get so complex that
2 we never actually gone to a resolution. It may be
3 time to revisit it in the 1.174 space.
4 MEMBER KRESS: I think that is a real
5 interesting question that we ought to have on our
6 table to think about.
7 MEMBER LEITCH: You will recall that we
8 had a licensee come in with an application for power
9 uprates a few months ago, and they were doing a number
10 of things.
11 But one of them was improving the
12 reliability of the stand-by liquid control system by
13 I think using enriched boron or I forget exactly how
14 they were doing it.
15 And they were making the case that this
16 power uprate was actually decreasing risk, because the
17 slick changes more than offset the other changes,
18 although it was not a fully risk-based analysis. So
19 it is not really a perfect example, but it shows how
20 one can play with the modifications a little bit and
21 get some strange things going on.
22 MEMBER ROSEN: But in that case that
23 brings up the question of whether the slick capacity
24 increase was integral to the change.
25 CHAIRMAN BONACA: That's right, and are

1 they related.

2 MEMBER ROSEN: And should in fact be

3 credited.

4 MEMBER LEITCH: Well, it seems to me --

5 MEMBER ROSEN: If they had not asked for

6 an upgrade, would they have done the slick change?

7 And the answer is no, and so it seems to me --

8 MEMBER LEITCH: But it is independent of

9 it. I mean, you could do the slick with or without

10 the --

11 MEMBER ROSEN: That is arguable.

12 MEMBER LEITCH: Well, the slick is really

13 independent of the power --

14 MEMBER ROSEN: But it is arguable.

15 MEMBER LEITCH: Well, it is arguable.

16 MR. GILLESPIE: I think you would end up

17 in this kind of condition that we probably would not

18 have approved the upgrade if the increased margin

19 wasn't there, because we have got a new fuel design

20 and some other things that are going on.

21 So it may in fact be integral to the

22 ability to have sufficient shutdown margin and some

23 other things. And that is the difficult part. You

24 have to get the system and the fuels people over here

25 to say how did you guys interact on that question.

1 I don't know that it is obvious that it is
2 not integral or it has set the conditions up such that
3 the upgrade could be approved.
4 MEMBER KRESS: Well, let me tell you how
5 I feel about that issue since we are just on the
6 subject. Now 1.174 allows Pat to come in and request
7 a risk-informed change of any type if he wants to.
8 Now, let's take one where we have got a bundle for the
9 two of them together, and pass all the 1.174
10 guidelines.
11 Now if I take the slick one, for example,
12 what that does is lower the risk. I could have had a
13 1.174 just for that change alone without anything
14 else. All right. That put me in a status of CDF and
15 LERF down there.
16 Now I say I have got a new condition. Now
17 I am going to do the power uprate. Now if the power
18 uprate fits the rules from that point, then that ought
19 to be allowed, too.
20 So if you bundle them together and you end
21 up there, that is the same thing as doing them
22 separately. So it ought to be allowed if you end up
23 with the bundle making you meet the criteria, because
24 you could have done it separately in a risk informed
25 change.

1 You could have done them separately and it
2 would have taken just twice as much business, that's
3 all.
4 MEMBER ROSEN: But the more difficult
5 situation is that the power uprate would not have
6 passed by itself.
7 MEMBER SIEBER: That's right.
8 MEMBER LEITCH: But that's all right then,
9 because you have a new plant, and then it passes.
10 MEMBER SHACK: But 1.174 disagrees with
11 you, I believe. They discuss bundling and I don't
12 think you are allowed to --
13 MEMBER KRESS: Well, that is not
14 surprising that 1.174 disagrees with me.
15 MEMBER WALLIS: Well, I think the slick
16 really was integral to the power uprate application.
17 It really reassured us that this was okay. That they
18 were tied together.
19 MEMBER KRESS: I don't think that is what
20 integral means though. But anyway I think that this
21 is probably a good fix, and I thank you guys. You did
22 as good as you can, and so we thank you.
23 MR. RICHTER: Thank you.
24 MEMBER KRESS: And I turn it back to you,
25 Mr. Chairman.

1 CHAIRMAN BONACA: Any other questions? If
2 not, we will take a recess until 10-of-1:00.
3 (Whereupon, a luncheon recess was taken at
4 11:51 a.m.)
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1 A-F-T-E-R-N-O-O-N S-E-S-S-I-O-N

2 (12:55 p.m.)

3 CHAIRMAN BONACA: All right. The meeting

4 is back and we have now a presentation about the ESBWR

5 Pre-Application Review. Since Dr. Kress is on some

6 official mission, we will start and Dr. Wallis will

7 lead us into this presentation.

8 I would like to just point out that the --

9 Dr. Ford?

10 MEMBER FORD: I have a conflict of

11 interest because I am a GE retiree.

12 CHAIRMAN BONACA: Okay. So you are not

13 allowed to say anything.

14 MEMBER FORD: You can still ask about

15 materials.

16 CHAIRMAN BONACA: You can ask questions,

17 but you can't answer any.

18 MEMBER FORD: You can ask questions of

19 fact.

20 CHAIRMAN BONACA: Okay.

21 MEMBER POWERS: And here comes Dr. Kress

22 so we can walk through this properly.

23 MEMBER KRESS: And we will get through it

24 a lot faster. I guess you guys have already

25 introduced this and started.

1 MS. CUBBAGE: I am Amy Cubbage, and I am
2 the project manager for the ESBWR Pre-Application
3 Review. I just found out my new organization's new
4 reactor section in NRR.
5 I just wanted to give a couple of minutes
6 overview of what the staff is doing in association
7 with the pre-application review, and then I will turn
8 the bulk of the presentation over to General Electric.
9 The pre-application review scope is listed
10 here, and we are looking at the TRACG application for
11 ESBWR LOCA and containment analyses, and qualification
12 of the TRACG code; the test and analysis program
13 description and PIRT, and we are also looking at the
14 SBWR and ESBWR test programs, as well as the SBWR
15 scaling report.
16 The product of the pre-application review
17 will be a safety evaluation report on the TRACG
18 application and testing program. Although the scope
19 of the pre-application review is very limited, GE has
20 submitted extensive volumes of documentation in
21 support of the review.
22 The staff has reviewed this information
23 and has generated over 300 requests for additional
24 information. All of these questions have been
25 discussed with GE in telecons and meetings that have

1 taken place over the last six months.

2 GE understands the staff's questions and

3 they have been very responsive to the issues. They

4 are in the process of preparing their responses to the

5 questions and those will be due back to the staff in

6 August.

7 MEMBER WALLIS: I am a little puzzled.

8 I'm sorry. I didn't ask you this question at the

9 subcommittee meeting, but how can you write a safety

10 evaluation report on a code? A safety evaluation

11 report has got to be on a substantial thing like a

12 reactor isn't it?

13 MS. CUBBAGE: We write safety evaluation

14 reports on topical reports that describe the analysis

15 methodologies.

16 MEMBER WALLIS: Then maybe when you do it,

17 we will ask you what the criteria have to be or

18 something, because this just sort of seems anomalous

19 to write about the safety of a code.

20 MR. LANDRY: If I may, Graham.

21 MEMBER KRESS: Safety evaluation reports

22 is just a name.

23 MEMBER WALLIS: It is just a name? Okay.

24 All right.

25 MR. LANDRY: Graham, this is Ralph Landry

1 from NRR from the staff. The safety evaluation report
2 on the code is a document that will define whether or
3 not the code adequately represents the phenomena that
4 we anticipate occurring in an accident or transient
5 condition in this particular design.
6 And the way in which we do that is review
7 the modeling in the code, and the correlations in the
8 code, and compare the code with the testing program
9 which has been testing phenomena in features unique to
10 this design.
11 And we look at those comparisons and
12 determine, yes, the code adequately represents the
13 phenomena that are anticipated to occur in this
14 design, and then write an SER which says that the code
15 is applicable to them, the ESBWR design.
16 MEMBER WALLIS: So the word safety is sort
17 of analogous, because there is no safety criterion
18 applied to this.
19 MR. LANDRY: Not at this time.
20 MEMBER WALLIS: Because as we all know,
21 you don't have safety criteria that apply to codes and
22 the way in which they represent data.
23 MR. LANDRY: The safety criteria come into
24 play when we do the design certification review.
25 MEMBER WALLIS: Right. That's right.

1 MEMBER SIEBER: Your SER though is limited
2 to the transients that you test it against, as opposed
3 to just saying that TRACG is good code for everything.
4 It is limited to ATWS and LOCA, and abnormal --
5 MR. LANDRY: Yes, that has always been the
6 case, that when we write an SER that we specify that
7 this particular version of the code is applicable to
8 these particular plants or these particular events.
9 MEMBER SIEBER: That's right.
10 CHAIRMAN BONACA: Thank you.
11 MEMBER SIEBER: And my notes say that you
12 had three of those, right; ATWS, LOCA, and abnormal
13 occurrences?
14 MS. CUBBAGE: For the pre-or-current scope
15 of the preapplication review, we are looking at LOCA,
16 ECCS, and containment. My next slide here for design
17 certification, the scope will include the other
18 applications.
19 However, transients, ATWS, and stability,
20 will likely be covered in a later phrase of the
21 preapplication review when we receive additional
22 submittals from GE. The schedule has not been set for
23 those yet.
24 MEMBER SIEBER: Thank you.
25 MS. CUBBAGE: And also --

1 MEMBER WALLIS: I am still a bit confused
2 about -- I'm sorry, but at the subcommittee we heard
3 a lot about why this is a good reactor and so on, and
4 really that is not part of the scope of this at all.
5 MS. CUBBAGE: That's right. The design
6 will be thoroughly reviewed during the design
7 certification basis.
8 MEMBER WALLIS: So does that mean that we
9 should ask GE to focus more on the experiments and why
10 they are good tests of the code, or should we hear all
11 the other material?
12 MS. CUBBAGE: Well, I think that the
13 design just provides the context for understanding the
14 testing and analyses that have been done, and so they
15 provided that as background information to you, as
16 well as to the staff, okay?
17 Well, that concludes my presentation. If
18 you have no other questions, I would like to introduce
19 Atambir Rao, who is the project manager for General
20 Electric.
21 MR. RAO: Good afternoon. We wanted to
22 make things absolutely clear so we brought our own
23 projector. Some of the questions on why the
24 presentation on the design. The approval of the code
25 is based on an application to a design, and so the

1 design forms the background for the basis for the
2 approval.
3 And also one of the key aspects of the
4 approval process is that we are relying on the fact
5 that this plant has a lot of margin in the responses.
6 So we believe that should make it easier for the staff
7 to find --
8 MEMBER WALLIS: Well, that's true, but
9 that should not influence our assessment about whether
10 or not TRACG is applicable, and the fact that it
11 predicts a big margin should not influence our
12 evaluation of TRACG.
13 MR. RAO: That's true.
14 MEMBER WALLIS: If we like the plan or not
15 is irrelevant.
16 MR. RAO: Well, that is -- yes. What I
17 will be covering a little bit about what we are doing
18 in the overall program, and give you a design
19 overview. As far as the overall program is concerned,
20 our approach has been to follow a step-wise program,
21 where technology closure or preapplication of PRA as
22 it is called is the first step towards certification
23 of the plant.
24 I believe the pre-application review is
25 more specific than this plant's application compared

1 to some of the others, where we are asking for a
2 safety evaluation report on the technology issues.
3 The overall design, I will assure you that
4 we have a lot of margin, and the margin is there by
5 design, and that we have also done a comprehensive
6 testing and analysis program.
7 The bulk of the presentation will focus on
8 the technology program, where we develop a
9 comprehensive plan and we have completed the
10 implementation of that plan, which includes both
11 testing and qualification, and the use of a single
12 integrated computer code for analysis with a well-
13 defined application methodology.
14 And what we are looking for from the staff
15 in the technology closure program is a safety
16 evaluation report for TRACG. And this is all part of
17 our overall plan to basically try to minimize the
18 regulatory risks.
19 When we started the SBWR program we
20 submitted the safety analysis report, and the design
21 certification application, and the computer codes, and
22 testing, were all being reviewed in parable. So it
23 was a little bit messy in that sense, and it was not
24 a productive use of resources.
25 So this time we felt that it was better to

1 follow a step-wise approach to both the design
2 development and the regulatory approval. In terms of
3 the design development, we over the last 15 years have
4 developed passive safety systems, which were then
5 integrated into a plant design for the SBWR.
6 And where we completed a detailed system
7 designs, PRAs, and looked to the building design. We
8 also as part of that effort did an extensive testing
9 and analysis program.
10 First we started the testing program, and
11 then we went back and defined it. A new program,
12 which was starting from scratch, which was a rigorous
13 process that we followed for defining what would be
14 the best needed to quality the TRACG computer code.
15 Then we went back and completed that test
16 program, and at that stage we concluded that the SBWR
17 was not economic at the 670 megawatts it was at. We
18 marked on this program for the ESBWR, which where the
19 E has now been defined as economic SBWR, and the
20 program started off about 10 years ago.
21 It was a one person operation, and it was
22 to improve the plant economics, and the design, and we
23 focused on optimizing the design, and we relied on the
24 economies of scale. We incorporated utility
25 requirements.

1 We had a utility steering committee that
2 has been and are still providing guidance ont he
3 design of the plant. And the overall program was a
4 market oriented program, and so we used the ABWR
5 experience basically using the same components.
6 It was our overall plan for
7 commercialization of this plan has been based on
8 building one plant at a time. We are not looking for
9 a six-pack. We will take one if it comes, but it is
10 based on the first plant has to be economical, and has
11 to meet all the commercial requirements.
12 So we are utilizing a lot of the ABWR
13 components in the design. So that is what we did on
14 the design, and we realized last year that it was now
15 time to come back to the NRC and start the regulatory
16 improvement process.
17 And again on this one, we focused on a
18 step-wise approach, and because the most fundamental
19 thing here is the design margin, and that is the most
20 important thing. That is what we made sure of, that
21 the design had plenty of margin and was simple.
22 And also to make sure that we had a solid
23 technology program, and I will describe what we did in
24 the technology program. What we are looking for a
25 safety evaluation report for TRACG, and we are using

1 a simple activity report, and I will show you a lot of
2 the details and some of the testing.
3 In fact, I will give you an overview of
4 the typical details and what they will be. It is too
5 hard to go over in a meeting like this. After that,
6 after we get closure on the technology, and a good
7 feel that there is no additional testing needed and
8 that the big part of the effort, the big uncertainty
9 regarding the computer codes is over, we will then
10 submit the safety analysis report for design
11 certification.
12 GE is committed to develop a license for
13 the ESBWR. The goals for the technology closure as
14 Amy had mentioned is basically approval of the use of
15 TRACG for analysis, and for vessel response to a pipe
16 break, and the containment response to a pipe break.
17 And the vessel response to anticipated
18 operational occurrences, and the submittals have
19 covered those areas. The AOO has been slightly
20 delayed because there is some additional information
21 required by the staff, and it will take us a little
22 more time to fill in that information.
23 The ATWS and stability area was also
24 deferred in the original sets of submittals just
25 because of timing. We wanted to make sure that the

first two especially, since those are the areas where there is a significant change in the technology, that we get those off the table, and that is why we focused on those two.

Even though I use the words significant change in the technology, I will also end up by saying it is the same as standard BWR technology by the end of the presentation. So that was something that was significantly new and different, at least in terms of what people had seen in the past.

And of course one of the elements of the approval of TRACG is the confirmation that the qualification base of TRACG is adequate. Just to put it in perspective, it is a 15-plus year comprehensive technology program, and the question is whether that is enough.

MEMBER WALLIS: This is on TRACG or on BWRs?

MR. RAO: On all the passive systems. And 10 years ago, the ESBWR started and the SBWR started more than 5 plus years before that.

MEMBER ROSEN: Can I ask for a clarification of your question? Is that enough for licensing, or enough forever, or what is the intent of that question?

1 MR. RAO: The intent of the question is
2 more rhetorical, and that they have been at this for
3 15-plus years. We would like to have some closure on
4 that. That is more of a rhetorical question.
5 MEMBER POWERS: Were Professor Apostolakis
6 here, he would say that you could have been wrong for
7 15 years.
8 MR. RAO: Could have been doing what?
9 MEMBER POWERS: You could have been doing
10 it wrong for 15 years.
11 MR. RAO: Yes.
12 MEMBER ROSEN: And also what I was going
13 at was that it is never enough. I mean, there will be
14 technology questions that come up once the plant is in
15 service, and you will be back to doing -- you know, it
16 is an ongoing thing.
17 MEMBER KRESS: I think that this is not
18 for certification.
19 MEMBER ROSEN: That's what I thought you
20 meant.
21 MR. RAO: Well, right now we have the
22 first step of certification to get approval of the
23 TRACG, and we need to close out the testing program.
24 It is a practical thing, you know, a countless
25 researching effort that --

1 MEMBER WALLIS: This is sort of like the
2 cry from Job is what it really is, isn't it?
3 MEMBER SHACK: He is in the wrong
4 business.
5 MR. RAO: I would like to finish it before
6 I have to retire. I am still young enough and still
7 have the energy. This just gives you an overall of
8 what has happened in the evolution of the BWRs. On
9 the top you will see that on the earlier BWR designs,
10 BWR-4 and BWR-6, and BWR-3, et cetera.
11 And on the top part, you will see some of
12 the key parameters of the design, and in the lower
13 part, you will see some safety related issues. And on
14 the last line, it will also give you a feel for the
15 overall economics.
16 What you see is that some of the
17 parameters are pretty much -- they have stayed in the
18 range where we have got experience. One of the things
19 that we wanted to make sure of was that he last 50
20 years worth of experience that we got from the BWR
21 technology when it comes to transients.
22 And as we have learned over the years is
23 that it is not the physics, and it is not the thermal
24 hydraulics. It is the materials that are the things
25 that are the biggest challenges.

1 In fact the chairman of our utilities
2 steering committee refers to those people who work in
3 the thermal hydraulics area as that we need to get rid
4 of the thermal-hydraulic mafia. These are not my
5 words. It is the chairman of the steering committee's
6 words.
7 MEMBER POWERS: Could we invite him for a
8 talk to assist the ACRS in its complaints.
9 MR. RAO: So the essence of --
10 MEMBER WALLIS: He has been trying to do
11 it, too.
12 MR. RAO: Yes. So what we have done in
13 the overall design out here is to make sure that we
14 use, and we do minimum extrapolations from operating
15 plants, because what you learn from the operating
16 plants, you want to make sure that you use it.
17 What you will see out here is, for
18 example, some of the big components, like the vessel.
19 The vessel diameter is the same as the ABWR. We did
20 not want to use the same factories that we have for
21 the reactor vessel for the ABWR. We wanted to build
22 a new factor, because you have got to get a plant
23 order one at a time.
24 So the vessel height is about 6 meters
25 taller than the ABWR, and it is just an extra ring in

1 fact. The number of bundles is one row extra over the
2 ABWR, and the fuel height is 3 meters, a little
3 shorter than the standard BWR fuel.
4 The power density is in the range of the
5 power density where we have got experience without the
6 power uprates. The power uprate have gone up even
7 higher than this, and some of the power uprates I
8 think for BWR-6, I think the highest one is about 62
9 kilowatts per liter.
10 So this thing is still well within the
11 range of where we have got experience. But what we
12 have done int his plant is to reduce the number of
13 components. We have gotten into the recirculation
14 pumps, and we have simplified the safety systems and
15 got rid of the pumps, the safety diesel generators,
16 heat exchanges that you have in safety systems.
17 And that shows up in the last two lines.
18 This is an interesting thing that has happened. The
19 evolution of BWRs over a period of time, and when you
20 go from left to right, you will see that the core
21 damage frequency as we evolved the designs basically
22 kept coming down, and the ABWR is down to about the
23 level to as low as you are going to get to
24 practically.
25 And that is a modest, best creditable,

1 core damage frequency that you are going to calculate.
2 Anything lower than that starts ending up in the range
3 of it being not credible.
4 The ESBWR is in the same range as the
5 ABWR, even though it has got a passive system. But
6 the reason to going to passive systems is shown on the
7 last line, which is that you have done it with a lot
8 less.
9 As we went from left to right, you can see
10 some of the earlier plants, the safety buildings were
11 much smaller than those for the BWR-6s and the ABWRs.
12 Now the reason for that is we added redundancy, more
13 divisions, more pumps, heat exchanges, to get an
14 improvement in the core damage frequencies.
15 But you pay a price for that, for the
16 complexities. What we have done in this plant is that
17 you get the same core damage frequency, but with less
18 stuff. So it is basically like I said a simplified
19 design , and the place to start is in the normal
20 operation.
21 The wa that we did that is to get rid of
22 the recirculation pumps. It is hard to imagine
23 anything simpler than that. The feedwater comes in
24 out here and flows up through the core, and it goes up
25 through the chimney, to the separators, and to the

1 dryers.

2 All that you do is pull the rods, and the

3 thing reduces 1,400 megawatts without any moving

4 parts. No balls bouncing around, and things like

5 that. The only thing that moves is bubbles.

6 MEMBER WALLIS: What is the flow regime in

7 the chimney? What is the lowest void fraction?

8 MR. RAO: It is about 80 percent.

9 MEMBER WALLIS: So it is a pretty high

10 void fraction.

11 MEMBER KRESS: That is dispersed droplet

12 regime, I think?

13 MR. RAO: Yes. Okay. So the drive and

14 separator, and the standard BWR drives and separators.

15 Again, the biggest challenge for BWRs is the

16 materials, and so we made sure that the pressure, and

17 temperature, and other conditions were either or the

18 same as that for any of the operating plants.

19 We didn't go and increase the operating

20 temperature or any other conditions. We were just

21 keeping it within the range of what we got experience

22 with. In fact, the fact that we are relying on

23 natural circulation, and the flow rates are a little

24 less, or the stresses would be a little less in most

25 of the components down in the core region.

1 There is one new compliment, which is
2 called the chimney out here, and there were some
3 questions in the subcommittee, and we will provide
4 answers later on at the next meetings.
5 Basically what we have done out here is
6 that we have got a much bigger vessel, 6 meters taller
7 than what the ABWR is. There are some advantages to
8 that. What it does is that it puts more water in the
9 vessel, which makes the operation of the passive
10 safety systems much better.
11 You will see that plant performance is
12 very benign, but we also need a bigger vessel to
13 enhance the flow during normal operation and natural
14 circulation.
15 So if you get rid of one or the other, you
16 still need a larger vessel, and the vessel does not
17 get much smaller. The passive safety and natural
18 circulation in a boiling water reactor is sort of a
19 natural combination.
20 You see a significant reduction in the
21 components, and this is an actual reactor system for
22 the ABWR, and we have eliminated all of that. We are
23 doing (inaudible) with controlled lower drives.
24 MEMBER LEITCH: Atam, I can't quite make
25 out what is going on in that power flow map down at

1 the bottom. How do you vary the power in this? In
2 other words --
3 MR. RAO: The power is controlled by
4 controlled lower drives, and there is no flow control.
5 This power flow map is plotted this way, but it is a
6 little confusing in the sense that in this plant the
7 power is what is controlled, and so that is what
8 should be on the X-axis.
9 MEMBER WALLIS: Well, those lines are
10 control rod settings aren't they?
11 MR. RAO: Okay. Those are ABWR. The
12 green is ABWR, and the red is BWR-5, and that is MELA
13 Plus.
14 MEMBER LEITCH: Okay.
15 MR. RAO: And the blue is the ESBWR. So
16 what we do in this, and you have to remember that the
17 power is the variable that you control, and you get
18 water flow coming from that.
19 MEMBER WALLIS: So you really control your
20 control rods setting, which is at that angle, and the
21 constant control rod setting is an angle line about 60
22 degrees or something, or 30 degrees.
23 MR. RAO: Right. Now, this one, what you
24 will do is that when you pull the parts out, you will
25 basically get a certain flow, and it is a fixed flow

1 that you will get.

2 MEMBER LEITCH: And you do that all the

3 way up to a hundred percent, right? You just keeping

4 pulling the rods out.

5 MR. RAO: Yes.

6 MEMBER ROSEN: The feed water system is

7 just making things level.

8 MR. RAO: Right. It is a very simple

9 machine. No moving parts, and people are worried

10 about stability in a boiling water reactor, and there

11 is matching circulation, and the reason for that is

12 that this is what the natural circulation flow line is

13 for. The BWR-4 is this and this is what it is for the

14 ABWR.

15 And this is where you get the instability

16 region. You can see that there is about 3 to 4 times

17 as much natural circulation flow in this plant

18 compared to those for the operating plant. And very

19 simply what we did was that when you get -- it is not

20 really hi-tech. It is single phase flow.

21 You get rid of the restriction out here

22 and the downcomer, and that in itself enhances the

23 natural circulation flow for a standard BWR by a

24 factor of two.

25 MEMBER WALLIS: Are you going to argue

1 that you cannot get into the instability region with
2 this?
3 MR. RAO: Right.
4 MEMBER WALLIS: That would be very
5 reassuring.
6 MR. RAO: There is no way to get out here,
7 you know.
8 MEMBER WALLIS: And you are going to show
9 us that in the future?
10 MR. RAO: In the future, yes.
11 MEMBER LEITCH: So the line -- I'm sorry,
12 but I can't quite make it out, but the blue line there
13 is the ESBWR?
14 MR. RAO: Yes.
15 MEMBER LEITCH: And at that point that is
16 a hundred percent?
17 MR. RAO: Yes. This plot is the average
18 power per bundle, and average flow per bundle. This
19 is not the standard power flow map, and we tried to
20 put it on to something that made sense.
21 MEMBER LEITCH: It looks like that line
22 bends back a little bit on itself there?
23 MR. RAO: Yes.
24 MEMBER LEITCH: So what is the
25 significance of that?

1 MR. RAO: This is what I am saying. This
2 gives people concern over questions that you have an
3 unstable situation here, and you have got to remember
4 that the thing that it is controlling is the power,
5 and not the flow.
6 So this should be the X-axis for the
7 ESBWR, the power. So you keep pulling the rods out
8 and you will get some flow, and that is what this is
9 showing.
10 MEMBER LEITCH: And what are you plotting
11 along the bottom there? I can't quite see it.
12 MR. RAO: This is the average flow per
13 bundle.
14 MEMBER LEITCH: Average flow per bundle?
15 Okay. I've got you.
16 MR. RAO: Just to put it in perspective,
17 the power flow ration is sort of a simple measure of
18 whether you get stable or unstable. It is just one
19 measure, and it is not the total measure. It depends
20 on the power shape and all the other things, okay?
21 So the power flow ratio, when you draw a
22 line from here up through that for the BWR-5 there,
23 you can see the power flow ratio is about the same at
24 the hundred percent power per bundle. This is the
25 power flow ratio per bundle.

1 MEMBER WALLIS: But of course the chimney
2 affects the stability of the circulation, too, and so
3 you are going to have to tie all of this together.
4 MR. RAO: Right.
5 MEMBER WALLIS: You can't just translate
6 the stability area from one rack to the other. But
7 that is not today's discussion.
8 MR. RAO: Right. I was just trying to
9 give a simplistic description of that.
10 MEMBER ROSEN: Atam, you said one thing
11 that puzzled me. You said that the only new component
12 is the chimney, but the chimney is not a component.
13 It is just a great big open hole. What do you mean by
14 component?
15 MR. RAO: Well, it is a big piece of
16 blueprint out there. It is just a channel.
17 MEMBER ROSEN: Is it one big open --
18 MR. RAO: No, it is .6 by .6 meters, the
19 partitions in there.
20 MEMBER ROSEN: So there are partitions?
21 MR. RAO: Yes, partitions in there.
22 MEMBER WALLIS: You have to lift the thing
23 out to refuel.
24 MR. RAO: No, you don't have to move it
25 out.

1 MEMBER WALLIS: You don't? You just sneak
2 around?
3 MR. RAO: You just go in and out through
4 that.
5 MEMBER SHACK: How much of the internals
6 could I remove in case I had a materials problem?
7 MR. RAO: All of them. They are designed
8 to be removable.
9 MEMBER FORD: So they are bolted?
10 MR. RAO: Yes, they are bolted. So what
11 we tried to do is that we have been learning over the
12 last 15 or 20 years, and one of the advantages of
13 having the 10 years to design it is that you pick up
14 all of the things that have happened in the last few
15 years.
16 MEMBER LEITCH: Could you get back to that
17 for just a second? Does the dryer go up into the head
18 as shown on that cartoon?
19 MR. RAO: I don't know whether there was
20 an actual vessel -- this is a cartoon, okay?
21 MEMBER LEITCH: Yes.
22 MR. RAO: I did not draw to scale on some
23 of the charts.
24 MEMBER LEITCH: I mean, I think that if
25 one should take the head of the dryer, the dryer is

1 still down below you is it?

2 MR. RAO: I don't know the exact location.

3 We might be able to see it in some of the later ones.

4 MEMBER LEITCH: Okay. There are some

5 actual drawings, and those that are drawn to scale,

6 and all the others are not to scale.

7 MEMBER LEITCH: You know, just one

8 problem. I had -- and this is a housekeeping thing,

9 but I had a problem opening that CD, and I could not

10 get the drawings. I don't know if the other committee

11 members had that same problem or not.

12 MEMBER WALLIS: I had some problem with

13 it.

14 MEMBER LEITCH: A proprietary CD from

15 General Electric, and I couldn't open it.

16 MEMBER WALLIS: It was mysterious. There

17 is no pdf, but some of them open and some of them

18 don't. I guess we can sort that out somehow.

19 MR. RAO: We can make some more different

20 ones, or we can make this one available, too. This is

21 not proprietary. The other thing that is kind of

22 interesting in this design is that we have combined to

23 reduce systems, and this is my personal favorite,

24 because what we did is that we got rid of the RHR

25 system.

1 There is no RHR system, and the major
2 innovation of this was that we took the standard
3 reactor water cleanup, which is the red line, and we
4 have given it a dual function now. It can perform
5 normal shutdown cooling.
6 Basically, a reactor water cleanup system
7 is pumps and heat exchanges, and that is what a water
8 shutdown cooling system is. So it takes it from the
9 vessel and puts it back into the vessel.
10 So what we did is for (inaudible) is that
11 we bypassed the regenerative heat exchanges and
12 removed the heat from these heat exchangers, and we
13 used the same pumps to bypass the defamilizers, and
14 put it back into the vessel.
15 So that reduces and makes it a lot
16 simpler. And it makes the operation also simple. It
17 is not just a complex system. What we have got now is
18 a full pressure shutdown cooling system.
19 When you shut down a normal BWR, the RHR
20 only kicks in at 400 psi. So this is a little
21 innovation.
22 MEMBER WALLIS: So the nozzle sizes are
23 small, and so that the break is not a great disaster.
24 MR. RAO: Right. The nozzle sizes here on
25 the bottom are 2 inch nozzles. So it is a very small

1 nozzle there.

2 MEMBER LEITCH: And those pumps, aren't

3 they much larger than the present design?

4 MR. RAO: Yes. You have two pumps there,

5 one for the high flow an done for the low flow.

6 MEMBER LEITCH: Oh, i see. Okay.

7 MR. RAO: So what we did on the design was

8 basically make the heat exchanger is bigger by a

9 factor of four. And the heat exchanger bigger by a

10 factor of four is not a big deal. So that heat

11 exchanger got bigger and we added a paddle and pump.

12 MEMBER ROSEN: And you also designed the

13 system for full pressure?

14 MR. RAO: Yes.

15 MEMBER ROSEN: But the shutdown system was

16 not.

17 MR. RAO: Yes. Well, the shutdown system

18 was not. So now you have got a full pressure shutdown

19 cooling system.

20 MEMBER LEITCH: But you got it essentially

21 free because you had the reactor water cleanup system

22 as a full pressure system anyway?

23 MR. RAO: That's right. That was the

24 innovation here. I mean, it is not rocket science.

25 MEMBER LEITCH: You have to make reactor

1 water cleanup have more pumping capacity, because it
2 is only like a 10 percent success rate.
3 MR. RAO: You can't do it on the operating
4 plants because it didn't make sense, because the
5 operating plants, the RHR system needed a safety grade
6 for decayed heat removal following an accident.
7 Now, this one, the safety grade decayed
8 heat removal system is a passive system. So now the
9 question is what do you do for normal shutdown.
10 That's why it works out here than on the standard
11 active plant.
12 MEMBER WALLIS: This could be a safety
13 system, too.
14 MR. RAO: But it adds to the costs.
15 MEMBER WALLIS: I mean, it could be used
16 in an emergency.
17 MR. RAO: It could be used in an emergency
18 and we use it in the PRA. It is identified in the
19 PRA. This is what passive safety systems are.
20 Basically everything is right here in the containment.
21 And it is very simple. What you have is the standard
22 BWR pressure suppression system.
23 MS. CUBBAGE: Adam, you need to use the
24 microphone.
25 MR. RAO: Sorry. So what you have got

1 here is that the reactor vessel, and then we went up
2 front he ESBWR in power, and the ESBWR had two
3 steamlines and they are both steamlines in this, and
4 we increased the number of steam lines.
5 We don't have to add a steam generator.
6 Just increase the number of steamlines. These are the
7 two feed water lines, and water comes in, and goes up
8 through the core, and comes out through the
9 steamlines.
10 These are the safety release valves, which
11 perform the same depressurization function that we
12 have on the standard BWRs for ADS function, automatic
13 depressurization system. They blowdown into the
14 depressurization system, and these are the quenchers
15 for that standard.
16 The only difference is that this pool of
17 water is down and raised off the base mat, and you
18 could provide water in the vessel back to the vessel
19 by gravity.
20 We added these pools up here, about a
21 thousand cubic meters, and the ones that you would
22 call the ECCS systems for this plant. It is a pool of
23 water with a thousand cubic meters in total. It is
24 not a big pool, and it provides water make up
25 following a s loss of pool density.

1 So this replaces all the ECCS systems
2 makeup,and the only other thing left is the decayed
3 heat removal, and that is removed through heat
4 exchanges mounted on the top of the drywell.
5 I show you another picture what is there.
6 So the containment is about the same size as an ABWR,
7 and all the safety systems are right in there. So
8 that is an overall simplification of the design.
9 And all we have is a low pressure water
10 makeup system, and no accumulators like in other high
11 pressure systems that could give your system
12 interactions. This is not to scale, and --
13 MEMBER LEITCH: Could you go back to that
14 previous one for just a moment?
15 MR. RAO: Yes.
16 MEMBER LEITCH: So in a loss of coolant
17 accident the drywell pressurizes and is there pipes
18 like the Mark-II blown down into the suppression pool,
19 or what is the flow pattern there?
20 MR. RAO: Right there. If you have a pipe
21 break here, it flows down through here like the ABWR.
22 MEMBER LEITCH: That is an annulus is it?
23 MR. RAO: Yes, that is an annulus, and
24 there are 10 or 12 of these off the top of my head.
25 There are 10 or 12 of these very large pipes, and they

1 go down into the suppression pool, and the horizontal
2 lines, like the Mark III and it is covered like a Mark
3 II.
4 So the initial blowdown was in the vector
5 suppression system. The only thing that is different
6 is after that the water make-up after that
7 pressurizes, and the water flows by gravity from these
8 pools in the vessel.
9 And after the water flows into the vessel,
10 and this is not to scale, and please note that this is
11 just in order to show how all the systems fit
12 together. These are the pools that I was talking
13 about and this is the vector suppression pool.
14 There is an isolation condenser which
15 takes care of removing the energy following a reactor
16 isolation and in this plant the release valves are not
17 open following the reactor isolation.
18 So it is a much milder transient than
19 those in other operating plants. So not only have we
20 made the accident response better, we have made the
21 plant transient response a lot better.
22 This line out here is the major innovation
23 of the old design, which is that this is the heat
24 exchanger for removing the decayed heat that goes into
25 the containment following a pipe break. The steam

1 goes up here and it is condensed in that heat
2 exchanger similar to an isolation condenser.
3 But since there is non-condensables in the
4 containment, they have to be removed from that
5 condensing heat exchanger. And those get removed
6 through this pipe that is here, which blows into the
7 wetwell, and that is all done by the pressure
8 difference between the drywell and the wetwell. No
9 moving parts, no valves, nothing.
10 It is always open, and so the decay heat
11 removal for this plant is --
12 MEMBER ROSEN: No vacuum breakers?
13 MR. RAO: No, there are no vacuum breakers
14 between the drywell and the wetwell.
15 MEMBER LEITCH: Now, how do you get high
16 pressure injection? Now, let's say you have a small
17 break LOCA.
18 MR. RAO: We don't have a safety grade
19 high pressure engagement system anymore. If you have
20 a small break LOCA, some of the energy initially will
21 be removed from the isolation condenser system.
22 We have a non-safety grade system that
23 controls our drive system, which provides water
24 makeup. We have actually increased the capacity of
25 that compared to that for operating plants.

1 So they are non-ECCS systems which can
2 handle small break LOCA from a realistic point of
3 view.
4 MEMBER LEITCH: So the drive system pumps
5 become safety grade then?
6 MR. RAO: No, no. I said they are non-
7 safety. We just made them bigger actually. What we
8 did was that we added a line which injects through the
9 feedwater alignment and it is hard to show that in all
10 of this.
11 MEMBER WALLIS: But if you don't
12 depressurize, none of this other water helps you.
13 MEMBER KRESS: That's right.
14 MR. RAO: Yes, you have to depressurize
15 for this other water. It does --
16 MEMBER LEITCH: The only method of
17 depressurizing is through the safety release valves
18 then?
19 MR. RAO: Normally because
20 depressurization is a very important factor in this
21 design, we went through a diverse depressurization
22 system. This is the standard ADS system for the SREs,
23 and we added another system on the depressurization
24 valves, and so there are different kinds of valves,
25 and they are very different than the standard ADS

1 valves.

2 MEMBER ROSEN: How big are they?

3 MR. RAO: The DPVs, I think it is about a

4 12 inch line.

5 MEMBER ROSEN: And they are squib

6 actuated? Have you ever tested one?

7 MR. RAO: We have tested a lot of them,

8 and I can show you an actual test of those.

9 MEMBER ROSEN: Wow.

10 MR. RAO: We have done a lot of testing.

11 MEMBER KRESS: Isn't that novel.

12 MEMBER SHACK: When you say you can make

13 a small break LOCA with either your control rod drive,

14 how big a LOCA are we talking about here?

15 MR. RAO: A 2-inch line.

16 MEMBER SHACK: A 2-inch line. The CRD

17 system is designed to handle a 2-inch line. We

18 increase the capacity over that for the operating

19 BWRs. We did a lot of things to improve the core

20 cooling, and that is shown up here.

21 But the biggest thing is we have got a

22 bigger vessel, and there is more water in the vessel,

23 and so you start off with more water, and so the loss

24 of coolant accident response is a lot better. You

25 don't have to rely on other systems.

1 And we keep the core covered following a
2 loss of coolant accident. I already mentioned some of
3 these things out here. So basically we improved the
4 plant response by design features, and very simple
5 design features, and nothing really fancy, you know.
6 It is just like of level of safety, you
7 know, and you put it together right and you end up
8 with a design which is a lot simpler. The same thing
9 with the decay heat removal area. Like I mentioned,
10 we added the full pressure normal shutdown cooling
11 system regarding the isolation condensers.
12 The major new system is a passive
13 containment cooling system.
14 CHAIRMAN BONACA: Could I ask you to go
15 back to number nine. I have a question.
16 MR. RAO: Sure.
17 CHAIRMAN BONACA: You have that bottom
18 line there which says increase security. I mean, did
19 you mean security or safety?
20 MR. RAO: I really do mean security,
21 because everything is inside the containment which is
22 (inaudible), and anyone who wants to get in there is
23 not going to last too long.
24 It is all inside the containment. I mean,
25 that is really a neat feature of this thing.

1 MEMBER RANSOM: How thick are the
2 containment walls?
3 MR. RAO: Two meters, 1-1/2 to 2 meters
4 thick.
5 MEMBER RANSOM: And I don't know if you
6 mentioned it, but you can show shore up the lower
7 containment and still keep the coolant covered.
8 MR. RAO: Yes. That is an interesting
9 feature and it does not show up out here, but the
10 lower containment is about 700 cubic meters, and I
11 mentioned that these pools are a thousand cubic
12 meters.
13 So it is a closed system now, and water
14 does not leave anywhere, and so we looked at all of
15 the different scenarios and combinations, failures,
16 and all the rest of it. So what you do is you can
17 easily plug the lower driver.
18 Now, when you end up with a closed system,
19 everything is finely tuned, because you are dealing
20 with -- you know, you have to make sure that you have
21 got the right amount of volumes everywhere, and we
22 looked at all the different combinations and different
23 failures.
24 So it is a finely tuned system in that
25 sense, and that is what it prepares for.

1 MEMBER KRESS: Does it --

2 MR. RAO: Yes, it is not as expensive.

3 MEMBER LEITCH: Those larger reactor water
4 cleanup pumps, how are they sealed? We used to have
5 all kinds of trouble with backing on reactor water
6 cleanup pumps. Are they can pumps or --

7 MR. RAO: Yes, I think they are the can
8 pumps. I don't know offhand, but I think they are the
9 can pumps.

10 MEMBER LEITCH: And that could be a real
11 maintenance problem.

12 MR. RAO: This is what the system looks
13 like. We got rid of a lot of the water systems in
14 this plant, but we still have enough of the water
15 systems that there is a number of non-safety water
16 makeup systems, okay?

17 So we have simplified them, and what is
18 shown here is the reactor water cleanup system that
19 fits in. This is the reactor vessel, and this is the
20 suppression pool, almost to scale.

21 This is the pool of water up on the top
22 where the heat exchanger is and the isolation
23 condenser, and the decay heat removal sit. This is
24 the containment boundary up here.

25 And you can see the core compared to the

1 suppression pool, and water can flow regularly down in
2 there. The only water systems (inaudible) is we have
3 reduced them substantially, because the reactor water
4 cleanup nozzles is in this part of the building, and
5 you have got the hydraulic control units there.
6 And you have the field pool and an
7 auxiliary cooling system which is out here. It will
8 cool all the pools and also clean up all the pools
9 that are existing in the plant. And the rest of it is
10 all gone. We have six floors of ECCS system in all of
11 that.
12 MEMBER KRESS: These heat exchangers that
13 are in the pools, are they completely separate in the
14 sense that each of them has its own line coming?
15 There is not a header?
16 MR. RAO: Each has its own line, and each
17 has its own separate compartment. The pools are not
18 connected.
19 MEMBER KRESS: The pools are not
20 connected. Of course.
21 MEMBER RANSOM: Are there any problems
22 with isolation with the reactor water cleanup system
23 and the feedwater systems? How are those isolated?
24 MR. RAO: They are just like standard
25 plants. One of the things that we have done now as

1 far as the reactor water cleanup system is concerned,
2 we put it in this part of the building, which is
3 actually structurally better than the standard reactor
4 building, because structurally this lower part out
5 here is going to be part of that structure, and it
6 part of the containment boundary. So in a sense it is
7 a pressure bearing.
8 MEMBER RANSOM: I am wondering if those
9 are squib closed valves, or redundant values, or --
10 MR. RAO: They are redundant valves, but
11 not squib valves for the reactor water valves.
12 MEMBER SHACK: Since I don't have pumps
13 any more how do I heat up the vessel before I start to
14 go critical?
15 MR. RAO: You just pull the rods and you
16 get heat i[after ==
17 MEMBER SHACK: Did you get the staff to
18 agree to that?
19 MR. RAO: After the first one, and we also
20 have -- we have both.
21 MEMBER ROSEN: What do you mean after the
22 first one? You mean after you got some decay heat on
23 the coil?
24 MR. RAO: Yes.
25 MEMBER ROSEN: After the first neutron you

1 mean?

2 MR. RAO: After that, you can just do

3 (inaudible).

4 MEMBER SIEBER: Now, it seems to me that

5 since you don't have any pumps for ECCS that the

6 importance of accuracy in TRACG is pretty high,

7 because everything is driven by a thermal head, and so

8 the demand on the code would be more than it would be

9 for a pump system. Is that correct?

10 MR. RAO: No, the answer to that is please

11 wait and I will answer that question. But the answer

12 to that question is most of this stuff can be done on

13 the back of an envelope. So hear me out and --

14 MEMBER WALLIS: Which is why you want to

15 approve a very complicated code, right?

16 MEMBER SIEBER: Yes, I have some envelopes

17 here.

18 MR. RAO: You have to keep the thermal-

19 hydraulics guys.

20 MEMBER KRESS: That is the reason for

21 keeping us though.

22 MR. RAO: The evolution of the containment

23 in the reactor building is shown out here, and you can

24 see that all the BWRs have suppression pools, and all

25 of them were on the base mats, BWRs raised off the

1 base mats.

2 This hash mark is the bar code for the

3 Mark I and Mark II, and the spent fuel pool. You can

4 see on the Mark III that we moved it down to grade

5 elevation. One of the advantages of having delayed

6 this program post-911 was the high spent fuel was an

7 issue that came up I believe in Connecticut and other

8 places. So one of the advantages --

9 MEMBER ROSEN: To put it down lower.

10 MR. RAO: Down lower, and in fact it was

11 actually a trade-off, in terms of costs and we don't

12 think that high pools are a problem, but in terms of

13 costs, ending up in those separate fuel buildings like

14 Mark III, it was sort of the thing to do.

15 MEMBER KRESS: Is it below grade?

16 MR. RAO: You will see some actual

17 sketches of grade. It is two-thirds below grade.

18 MEMBER KRESS: Two-thirds?

19 MEMBER ROSEN: You mean the whole plant is

20 two-thirds below grade or just the pool?

21 MR. RAO: The elevation of the spent fuel

22 pool.

23 MEMBER WALLIS: But it could be lower.

24 MR. RAO: It could be lower, but it is

25 just that this is the optimum design. I mean, you

1 have got to remember that you have got two meter thick
2 walls. I mean, there is nothing that can really do
3 any damage to any of these plants, and all the studies
4 have shown that. That is not a real issue. It is
5 just more feels good.
6 MEMBER LEITCH: So there is really no --
7 what we might have called reactor building in previous
8 BWRs. In other words, everything is inside
9 containment here.
10 MR. RAO: Well, no, if you want to use the
11 terminology reactor building and reactor water cleanup
12 system, this part out here is the reactor building.
13 MEMBER LEITCH: But it is in containment
14 though, right?
15 MEMBER WALLIS: No, it is not a
16 containment.
17 MEMBER LEITCH: It's not in containment.
18 MR. RAO: The different boundaries go up
19 like this.
20 MEMBER LEITCH: Okay.
21 MR. RAO: So that is the outside
22 containment there, and hydraulic control units and the
23 reactor water cleanup system outside.
24 MEMBER KRESS: That's so you don't have to
25 work that region?

1 MR. RAO: Pardon?

2 MEMBER KRESS: Is that so that you don't

3 have to inert that region?

4 MR. RAO: Well, we kept it outside -- yes,

5 that region is not inerted. You do maintenance on the

6 hydraulic control units and reactor water cleanup and

7 that;s it.

8 A couple of other things is that we have

9 added an entire fuel transfer system, which should

10 make the utilities life a lot easier, because you can

11 move fuel up and down with a spent fuel pool, and

12 during operation it takes it off the critical path.

13 The reason that you can do that in this

14 plant compared to the Mark III is the top of this

15 thing is outside the containment now. In the Mark

16 IIIs that is part of the containment. So you have got

17 to move during an outage.

18 In this one, you can move it and what we

19 have done is we have reduced the safe buildings. You

20 can see that we got rid of 6 floors of safety grade

21 ECCS, and heat exchangers, and heat controls, and all

22 of that.

23 We have on this plant shown something on

24 the outside called an external event shield. We have

25 not defined what requirements are there. We can make

1 it probably a revolving requirement on what is
2 required for us to do in that area.
3 So the design is flexible in that sense.
4 This is actually to scale and Graham has left, and he
5 claimed that the drawings are not according to scale,
6 but this is an actual section of the plant.
7 And you can see that it is actually a
8 fairly simple plant. The reactor vessel, and fuel
9 pipes, and reactor water cleanup system, and hydraulic
10 control units, and pools of water.
11 MEMBER ROSEN: And grade is again -- show
12 me.
13 MR. RAO: Grade is right here.
14 MEMBER ROSEN: Right there? Okay.
15 MR. RAO: This is the spent fuel pool, and
16 this is the inclined fuel transfer system, and this is
17 the fueling machine, and this is the fuel cooling
18 system. So that is all of the systems, and the
19 accumulators for the standby liquid control are
20 somewhere out there, and you can see them in a
21 different section.
22 MEMBER ROSEN: And this external event
23 shield that you talked about, is it talking about how
24 big or how thick the walls are on the rectangular
25 cross-section part of the vessel or part of the

1 plant?

2 MR. RAO: This one, we have not defined

3 the thickness, no.

4 MEMBER ROSEN: Of the external event

5 shield. Oh, it is that piece?

6 MR. RAO: It goes over --

7 MEMBER ROSEN: But it doesn't go over the

8 other piece?

9 MR. RAO: No, it doesn't go over this

10 piece.

11 MEMBER ROSEN: Because all the fuel is way

12 down low?

13 MR. RAO: Yes, the fuel is way down low.

14 CHAIRMAN BONACA: One thing that I noticed

15 in this design is that you have a lot of bundles, a

16 thousand bundles. How long will it take you before

17 you have to begin to off-load spent fuel from that

18 pool?

19 It seems to me like you have almost a

20 permanent operation to dry storage.

21 MR. RAO: The size of the spent fuel pool

22 right now is good for 8 years. One of the advantages

23 of having a separate fuel building is you can increase

24 the size and make it part of the initial investment

25 cost.

1 Standard fuel, you can move about 5 or 6
2 years, and if you go to MOX fuel, it is a little
3 longer. Ten years is what the Europeans require. So
4 if this were built in Europe, and they had MOX fuel,
5 they could end up with a slightly bigger fuel
6 building, but it would not affect the rest of the
7 design of the rest of the plant. So it is kind of
8 flexible in that sense.
9 MEMBER ROSEN: And Graham, you are going
10 to tell them that it is to scale?
11 MEMBER KRESS: You might let him know.
12 MR. RAO: To scale.
13 MEMBER WALLIS: Do I get to applaud?
14 MEMBER SIEBER: Let me ask a question that
15 will demonstrate my failure to fully understand. When
16 you have an accident or a transient in the plant,
17 ultimately the decay heat from the reactor is up in
18 the PCC pool, right, through the heat exchangers that
19 ar up there?
20 MR. RAO: That's right.
21 MEMBER SIEBER: How do you remove the heat
22 load from the PCC pool outside the building?
23 MR. RAO: Okay. If you get a normal
24 vector isolation, you can remove it with the active
25 fuel pool cooling system.

1 MEMBER SIEBER: Okay.

2 MR. RAO: You can do that. That is an

3 active, non-safety fuel pool cooling system. So the

4 pool doesn't really have to boil. It takes about 3

5 hours or 4 hours before --

6 MEMBER SIEBER: And if that fails, then

7 you are relying on the boil over?

8 MR. RAO: Then it just boils off.

9 MEMBER SIEBER: It boils off. Okay. And

10 how long does that last?

11 MR. RAO: For 72 hours.

12 MEMBER SIEBER: So you have got to put

13 more water in there.

14 MR. RAO: All you have to do is provide --

15 MEMBER SIEBER: Call the fire truck,

16 right.

17 MR. RAO: -- 200 or 300 gallons per

18 minute, and that's all you have to provide. It is not

19 big, and it is low pressure, and it is outside

20 containment, and we have got a connection to that, and

21 that's all you do.

22 MEMBER SIEBER: Okay. Thank you.

23 MR. RAO: This is the spent fuel refueling

24 floor, and it controls the building size, and you can

25 see that this is a pool for storage of either spent or

1 new fuel, and there is not enough time to cover all of
2 these issues. This is the reason that we are here.
3 TRACG.
4 Now that was just an overview of the
5 design. I am notorious for exceeding my time, and I
6 will keep watching my watch out here.
7 MEMBER WALLIS: Well, it is a matter of
8 doing it full-scale and not distorting it are you?
9 You distort the dimensions of time as well.
10 MR. RAO: What we have done in this plant,
11 and what this shows is these are the codes that we
12 used for the operating BWRs, and for doing the
13 different analyses.
14 For the ESBWR, we are using some of the
15 same, but we are switching using TRACG for most of the
16 application. This is a proven code, and for those of
17 you who have worked with codes know that it takes 15
18 or 20 years before people start feeling comfortable
19 with some of these codes, you know, and to take all
20 the bugs out.
21 So this one has been around for 25 years.
22 I remember going to Los Alamos for the first time
23 almost 20 years ago, or 17 years ago, and talked to
24 the people there who are using such codes.
25 MEMBER WALLIS: That is one of the

1 problems with these codes, of course. They all have
2 the same roots.
3 MR. RAO: They all came from Los Alamos?
4 MEMBER WALLIS: That's part of the
5 problem, yes.
6 MR. RAO: But we are taking the bugs out.
7 That is why G is our last initial up here. The
8 overall technology program is shown up here. It is a
9 very comprehensive program. What we did was that we
10 started with a program, and we looked at the PIRTS and
11 looked at what the important phenomena were, and
12 developed what the board called the test and analysis
13 plan.
14 Then we ran some tests were used to
15 qualify the computer code. We did model bias and
16 uncertainties, and we did a scaling report, and to
17 make sure to test for scale drive, and on the side out
18 here we first developed the TRACG code, and learned
19 all the creations and made sure that it could do the
20 analysis for both the reactor vessel and the
21 containment, and that was in your application.
22 And after that, you get a validated code,
23 and then you define an application methodology for
24 using that code, and the code can't be used just
25 generally.

1 I mean, you can use it, but it has to make
2 sense. So we have defined an application methodology.
3 Now that is what we are asking the staff for an SER
4 on, on the approval of the code, along with the
5 application methodology of that code.
6 Then we will do the safety analysis report
7 up here. So these are all the different elements of
8 the technology program, and I will give you a feel for
9 some of these so that you get a feel for how complex
10 and comprehensive this has been. There is not enough
11 time to go into detail, but --
12 MEMBER WALLIS: So part of this
13 application is this model bias and uncertainty part,
14 where you show how you take care of that?
15 MR. RAO: Right.
16 MEMBER KRESS: Didn't we hear that tone
17 before?
18 MEMBER WALLIS: In association with
19 something like the AOO transients or something for
20 different reactors?
21 MEMBER KRESS: Yes, for the AOO transients
22 we heard about.
23 MR. RAO: Yes, that is for the AOO
24 transients, but we went beyond that. Now, this is a
25 LOCA applications and for the containment analysis

1 also.

2 MEMBER RANSOM: It is interesting that you

3 mentioned bugs, and one bug that we found in TRACB and

4 TRACG came from TRACB, was when they attached a line

5 to the vessel at somewhere other than the center of

6 the node, they had not accounted for the hydrostatic

7 pressure difference between the center of that node

8 and the line attachment.

9 And I am wondering was that corrected in

10 TRACG?

11 MR. RAO: I am not knowledgeable enough to

12 answer that.

13 MEMBER RANSOM: Is Bharat here?

14 MR. RAO: Bharat had to take an earlier

15 fight and he is gone for the day.

16 MEMBER RANSOM: I am wondering if -- well,

17 you didn't bring Bharat?

18 MR. RAO: We did bring him, but he was on

19 an earlier flight. The meeting was in the morning,

20 and he had planned to be at the morning meeting. In

21 fact, one of the reasons that I am looking at my watch

22 is not only that I have to not exceed my time, but I

23 have a flight to catch. I will finish on time.

24 MEMBER KRESS: Could you tell us just a

25 little more about the application methodology.

1 MR. LANDRY: From what we have seen, yes,
2 our understanding that has been corrected. But we
3 will look just to be further just to be sure. Our
4 understanding of it right now is that it has been
5 corrected.
6 MEMBER KRESS: Just a few words by what
7 you mean by the application method on it.
8 MR. RAO: Okay. I have a few more charts
9 to describe, but basically you take a computer code,
10 and how do you account for the uncertainties.
11 MEMBER KRESS: Oh, that sort of thing?
12 MR. RAO: Yes, that sort of thing. This
13 is a realistic code. How do you account for the plant
14 parameters, for example.
15 CHAIRMAN BONACA: And the nodalization and
16 sensitivities, and all of that.
17 MR. RAO: The nodalization, yes, and what
18 we did -- and so what I am going to do is just go over
19 some of these boxes, and give you a feel for what we
20 have done. It will just give you a feel.
21 If you want me to cover all of these
22 charts in detail, they are in your handouts. First,
23 we developed an overall test and analysis plan, which
24 consisted of going over the governing phenomena, and
25 doing PIRT, to bottom-up, and top-down processes. We

1 looked at the highly ranked phenomena, and --

2 MEMBER KRESS: Where did you get your

3 experts for the PIRT?

4 MR. RAO: The PIRT experts came from BWR

5 experts who have been working with us over the years

6 on --

7 MEMBER KRESS: They are GE employees?

8 MR. RAO: It was GE employees, but we had

9 other people also.

10 MEMBER WALLIS: You even had a professor.

11 MR. RAO: We even had a professor.

12 MEMBER ROSEN: Which just shows that they

13 are not excluded.

14 MR. RAO: He used to teach at Berkeley.

15 MEMBER KRESS: That makes it a academic

16 exercise, I guess.

17 MR. RAO: So we followed a rigorous

18 process to define the technology plan. It is very

19 extensive, and I have taken out all the tables that we

20 had prepared for that.

21 That was initially done for the ESBWR, and

22 then when we came to applying it to the ESBWR, we said

23 let's look at the differences between the ESBWR and

24 SBWR. This is a summary of the differences between

25 the ESBWR and SBWR.

1 We basically increased the power, which
2 has affected several things, and we did change the
3 plant systems and the buildings. Like I mentioned, we
4 increased the number of steam lines from 2 to 4, and
5 we increased the number of bundles.
6 We changed the height also. The SBWR was
7 2.7 meters, and we have gone to 3 meters on this one.
8 We have added more isolation condensers. As you were
9 told before, we did not just go up in power. We added
10 more decay heat removal systems to the plant, and it
11 was not just a power uprate.
12 We increased the -- the fashionable thing
13 is to get another 5 or 10 percent, or 20 percent more,
14 out of the same system. We added capacity. We
15 increased the isolation condenser capacity by 50
16 percent.
17 We increased the decay heat removal
18 capacity by 80 percent. We basically now have four
19 units, and we previously had three units, and we
20 increased the size of the units.
21 So one of the good things about this
22 design is it is fairly easy for us to add more decay
23 heat removal capacity, because we are not removing it
24 from the containment boundary, or from the vessel
25 boundary like some of the liquid metal or gas

1 reactors. We are removing it through heat exchanges.
2 And those heat exchangers are -- they are
3 not cheap, but we increased the size of the units.
4 MEMBER KRESS: Let me ask you a question.
5 In your test and analysis program that you did for
6 SBWRs to qualify the TRACG, you developed a scaling
7 process using PI groups.
8 Was your PI group acceptance criteria the
9 same for SPWR as it is for the ESPWR?
10 MR. RAO: We have the scaling expert here.
11 MR. GAMBLE: Hi, Bob Gamble from GE.
12 There was actually a very subjective criteria used on
13 the SPWR. There was no quantified value.
14 MEMBER KRESS: You didn't use from 5 to 2?
15 MR. GAMBLE: No, that kind of developed I
16 think through the AP-600 program. Prior to that, no
17 one had really come up with the idea of a quantified
18 criteria.
19 So seeing that, we adopted it, and ours is
20 slightly different than theirs. So now we have --
21 MEMBER KRESS: Now you have on-third to
22 three.
23 MR. GAMBLE: Correct.
24 MEMBER KRESS: But my question is whether
25 that is different than what you used for SPWR?

1 MR. GAMBLE: In SPWR, we just looked at
2 the PI groups and subjectively argued whether they
3 were close enough or not. There was no criteria.
4 MEMBER KRESS: So you had no criteria?
5 MR. GAMBLE: Correct.
6 MR. RAO: What we did on the plant systems
7 and buildings was we did increase the system sizes and
8 capacities, but we did not increase the numbers. For
9 example, the reactor water cleanup system was a two-
10 train system, and it is still a two-train system, and
11 the fuel cooling system was a two-train system. It is
12 still the same, except that it is bigger pumps, and
13 bigger pipes.
14 We did utilize a little innovation, and
15 again not hi-tech stuff, but innovation. We used the
16 pools when they empty out, it opens up air space, and
17 that can help us reduce the containment pressure
18 following an accident.
19 So we basically are taking credit for
20 that, which gave us an additional 15 percent increase
21 in retro volume, which then translates into 15 percent
22 lower containment pressure following an accident,
23 which then allows us to reduce our design pressure by
24 about 15 percent, and make it the same as the ABWR
25 now.

1 So we are now in the same range, and there
2 is a whole trust out here to make us the same as ABWR,
3 because we use everything the same. And that was one
4 of the advantages of what we did out here.
5 We did do a major building optimization,
6 including transferring non-safety systems out of the
7 safety grade buildings. So that is one of the reasons
8 that we reduced the size of the safety grade building,
9 and we also ended up in a different building for the
10 spent fuel storage.
11 But the bottom line of all of this is that
12 the differences do not affect the governing phenomena
13 for normal operation transients and accidents. It is
14 pretty much the same as the SBWR when you look at it
15 from a hydraulics point of view.
16 So that program that I mentioned earlier
17 which defined what was needed to qualify the code for
18 all the different phenomena, resulted in a test
19 program. This shows you the results of the test
20 program, and there is not enough time to cover all of
21 them.
22 You can see that they were best done at
23 different scales and at different facilities, and by
24 different organizations, and a very extensive test
25 program all over the world.

1 MEMBER WALLIS: Well, a thousand scale
2 doesn't mean that it is something like using a little
3 matchbox car model and a model Cadillac. It means
4 that it was pretty well full height isn't it?
5 MR. RAO: Exactly. When you see the last
6 one, the PAMDA is the biggest test facility that we
7 have got. It is a full high test facility, and it is
8 1/50th --
9 MEMBER WALLIS: It is a thousandth in
10 cross-sectional -- well, what is the one-thousandth
11 part? Is it the thousandth in cross-sectional area?
12 Because the thousandth in linear dimension is sort of
13 absurd.
14 MR. RAO: That is the full height, and
15 power also. It is power and you can look at it at
16 one-thousandth power. This facility is a huge
17 facility. I think it is the biggest test facility for
18 testing safety systems, and it is full height, which
19 is about 27 meters I think from top to bottom.
20 CHAIRMAN BONACA: Is it a GE facility?
21 MR. RAO: No, it is owned by Paul Sheridan
22 Steel in Switzerland.
23 CHAIRMAN BONACA: Oh, I see.
24 MR. RAO: This is the depressurization
25 valve.

1 MEMBER WALLIS: Which one is it, that big
2 one?
3 MR. RAO: This one.
4 MEMBER SHACK: Oh, this is the promise
5 that you made before.
6 MR. RAO: This is the squib valve. This
7 is the actual valve, and in a sense it is a rupture
8 disk. Well, rupture disk gives the wrong impression.
9 It is sheared off.
10 MEMBER ROSEN: Do you in some place use
11 the reliability of that in the PRA?
12 MR. RAO: Of course. We have done a test
13 program.
14 MEMBER ROSEN: And have you got the data
15 for how reliable this valve is from that?
16 MR. RAO: Yes.
17 MEMBER LEITCH: How many did you do, one
18 tests, two tests, 10 tests, a thousand tests?
19 MR. RAO: Ten.
20 MEMBER LEITCH: And they all passed, I
21 assume? Then you extrapolated from that.
22 MR. RAO: Yes, there is a whole test
23 report on that, a 500 page report that has been done,
24 and we can share that with you. I know that you asked
25 the other guys the same questions.

1 MEMBER LEITCH: It seems like a pretty
2 good question to me. If you are going to build a big
3 break LOCA into your system, you ought to make sure
4 that when you want it, you get it; and when you don't,
5 you don't.
6 MEMBER LEITCH: And how many of those are
7 there?
8 MR. RAO: Six.
9 MEMBER LEITCH: Six conventional relief
10 valves?
11 MR. RAO: Well, 12. So this is the full
12 scale DPV, and that was done somewhere in Southern
13 California, I believe. This is the facility in
14 California which was tested and it shows that water
15 flows down in California by gravity also.
16 This was the vacuum breaker full-scale
17 test, and this is the test facility in Switzerland for
18 the integral testing of the DPV systems. This is a
19 full-scale decay heat removal condenser.
20 MEMBER ROSEN: When you did the reactor to
21 the depressurization test, you gave out ear plugs to
22 everyone?
23 MR. RAO: Yes, I think it was out there
24 somewhere.
25 MEMBER WALLIS: Now, Atam, this is nice to

1 know that these exist. Now the real question is
2 whether or not this program is adequate enough to
3 support the future licensing of the plant like this,
4 and the only way we can determine that is to go into
5 details, which you are not going to present today.
6 MR. RAO: Right.
7 MEMBER WALLIS: So this is very much an
8 overview.
9 MR. RAO: It is an overview. The details,
10 like you said, the reports are, oh, 5,000 pages.
11 MEMBER WALLIS: But the justification of
12 why this is adequate would take us some time to
13 evaluate, I think.
14 MR. RAO: That is definitely the case, and
15 that is why the staff is reading them and they are
16 doing a yeoman's job of going through them. I mean,
17 the number of pages of the reports, it is extensive.
18 I am just trying to give you an overview.
19 But it is a lot of pages. These days it now fits on
20 CDs, and so it a lot of CDs.
21 MEMBER WALLIS: But is there some sort of
22 executive summary that says why these number of tests
23 is adequate, and these facilities are adequate? Is
24 there some sort of concise argument that would satisfy
25 us, or do we have to read through all these reports?

1 MR. RAO: You will probably have to read
2 the TAPD, which is the --
3 MEMBER WALLIS: Which is the central thing
4 to go to?
5 MR. RAO: Yes. That is the one that gives
6 the overall plant and lays out the road map. That is
7 a fairly comprehensive document. It is not that long,
8 300 or 400 pages.
9 There were additional tests done that we
10 have qualified the TRACG computer code against, and in
11 fact some were performed after the SPWR program was
12 terminated, and we recall the PAMDA P-Series test, and
13 there was some done also in Japan at a test facility
14 run by CRIEPI.
15 MEMBER WALLIS: But this is an Ontario
16 hydro test isn't it, which is rather important for the
17 chimney? Or is that the CRIEPI?
18 MR. RAO: Well, we list all of them there.
19 MEMBER WALLIS: Okay. You did not list
20 them on that previous slide.
21 MR. RAO: So this shows some of the tests
22 that were done showing the same test program. The
23 previous chart listed all the tests, and the
24 qualification report is about a thousand pages. It is
25 two volumes.

1 So it is a huge report. And it covers a
2 lot of tests. You can see the circulation of the
3 vessel, and we looked at separate performers, and
4 chimney wide fraction, and this was the testing done
5 in Canada.
6 And the start-up flow oscillation, and
7 mixing, and it is an extensive test program, and we
8 went about it systematically trying to fill in the
9 holes that we had found.
10 I can tell you the history about the
11 chimney design also. Initially, we started off with
12 an open chimney, and no partitions, and all that we
13 had at that time was some published Russian data.
14 We had to read it off a little report
15 paper,a nd we said, gee, that is not enough, and so
16 that is when we went with partitions, and that's when
17 we initiated the testing in those many items.
18 So we went about it systematically.
19 Whether it was natural circulation, or the containment
20 and safety system technology, you can see that we did
21 a lot of testing. Individual fuel condensation, and
22 look at all the test facilities that were involved.
23 Some were at MIT, U.C. at Berkeley, and
24 GIRAFFE was in Japan, and PANTHER was in Italy;a nd
25 PAMDA was in Switzerland. We looked at the

1 performance of the heat exchangers, and looked at
2 system interaction, and we looked at suppression pool
3 stratification, and stratification of the drywell and
4 looked at quenching.
5 We supplemented these. No, there were
6 tests that were done in other organizations which
7 extended the database that was done for the SPWR,
8 which covered even more severe conditions than had
9 been tested before.
10 MEMBER WALLIS: So you had systems that
11 actually simulated entire transients?
12 MR. RAO: We covered -- there was no one
13 test that covered it all from zero to the end, but we
14 had a level that has given us confidence, and we
15 covered all the bases.
16 MEMBER RANSOM: Atam, did you find that
17 the chimneys were really necessary, the partitions in
18 the chimney to overcome geysering or slugging in the
19 open arrangement?
20 MR. RAO: No, we didn't add the chimneys
21 for the geysering concerns. We added them just
22 because of the uncertainties associated with an open
23 chimney during --
24 MEMBER RANSOM: So you don't really know
25 whether you need them or not then?

1 MR. RAO: Right. In fact, there was a
2 long debate when we were deciding to put in the
3 partitions, and we said that we would put them in and
4 be conservative with that, and if you don't need them
5 after some time, then we can take them out.
6 MEMBER WALLIS: I would think that you
7 would need them.
8 MR. RAO: We put them in because that area
9 is --
10 MEMBER RANSOM: Well, you mentioned the
11 Russian data. What did that concern? I mean, did it
12 concern the need for them, or --
13 MR. RAO: No, no, that was just a void
14 fraction in general. It was very small. It was much
15 smaller than the interior hydro channels.
16 MEMBER WALLIS: Now, were these short big
17 vessels where the steam tends to go up one side and
18 get a non-uniform flow?
19 MR. RAO: Well, we put the channels in
20 there.
21 MEMBER WALLIS: We don't need to discuss
22 it.
23 MR. RAO: Then what we did was we ran
24 these tests, and then we compared the TRACG computer
25 code, and this shows the next couple of plots. It is

1 hard to read all of this, but I just wanted to give
2 you a feel for it.
3 What we did was that we compared the TRACG
4 against several test data and this was a component
5 data, and Patsy did a dam good job. You can see how
6 here different tests out here, and this high
7 condensables, and this is only with steam.
8 Again, not enough time to go into all of
9 these, but what you can see is that TRAC does a dam
10 good job. It helped us define the bias of the
11 uncertainties and the predictions using TRAC as a
12 realistic code.
13 MEMBER WALLIS: There is no tuning of
14 TRAC?
15 MR. RAO: No tuning of TRAC. These were
16 TRACG predictions of integral tests, and a prediction
17 of the drywell and the wetwell pressure, and the
18 dashed line is TRACG. It is hard to see that in the
19 actual pictures.
20 It does a dam good job of that. Another
21 figure of merit is this calculation of the amount of
22 energy removed in this integral test, and that is
23 measured by the pool level in the PCCs, and you can
24 see that it does a dam good job of that.
25 It misses a few details shown out here.

1 This is the flow into each of the three PCCs. In this
2 particular test facility, there were three PCCs, and
3 two of them removed more energy than the other one,
4 and one actually sort of went to sleep is what we call
5 it.
6 But the integral performance is pretty
7 good. So in summary we had a comprehensive, well
8 efficient program, and like you said, it is a thousand
9 page report, and what we call the base qualification
10 of the capacity systems.
11 We did another qualification report, which
12 is about another 400 or 500 page report. So this is
13 about 1,500 or 2,000 pages worth of qualification that
14 the staff is reading.
15 They are fast readers and they are on a
16 tight schedule, and they have done a great job on
17 that.
18 MEMBER WALLIS: But you have not replied
19 to the RAIs?
20 MR. RAO: We are doing it. We are working
21 together.
22 MEMBER WALLIS: Since you are saying all
23 the good things that you have done, I had to remind
24 you of that.
25 MR. RAO: No, we will reply to the RAIs.

1 We provided draft responses to some of those
2 questions, and we provided draft responses to about a
3 hundred I think out of those 300, and so it is now
4 just a question of formalizing the responses. So it
5 is doing well, believe me. Trust me.
6 MEMBER WALLIS: Fatal words.
7 MR. RAO: We want the staff SER on October
8 15th,a nd so we will do whatever it takes to make that
9 happen. We want closure, okay? This shows the
10 effective scale of different test facilities, and
11 again it is hard to see. These are different test
12 facilities, and they are at very, very different
13 scales.
14 They are 1-by-1,000, and 1-by-50, and some
15 with helium and some without helium. This was -- you
16 can't see any of the details out here, but what you
17 can see is that they all follow along this line out
18 here, which shows that they are pretty close to what
19 we expected them to show. This was the components for
20 the --
21 MEMBER WALLIS: Now, what we said at the
22 subcommittee was that it would really be nice since
23 TRACG is what is in question here, if you had TRACG
24 predictions with all of these results, and that
25 comparison is going to be very well made in your

1 application, right?

2 MR. RAO: We are focusing right now on

3 answering the RAIs, and after that we will put that on

4 the things to do. So these are tests at different

5 scales. You know, very different scales.

6 These components, you know, these were the

7 heat exchangers, and some of these were full-scale,

8 and some of them were a slice, some of them were just

9 three cubes. So you can see that the performance

10 is --

11 MEMBER WALLIS: Scaling works is what you

12 are saying.

13 MR. RAO: Yes, scaling does work. In

14 summary, for the technology program, what you see is

15 that we have improved the performance by design

16 features, and we have used qualified methods

17 basically. What we are doing -- and this is where I

18 describe what we are doing in the application

19 methodology.

20 It is basically used for calculations and

21 this is something that we have already reviewed. We

22 are using realistic calculations and with simplified

23 accounting of uncertainties.

24 Until 2 days ago, we were using bounding -

25 - no conservative calculations for the containment and

1 the LOCA. So what we have done is that we are
2 accounting for the uncertainties.
3 And we can use a simplified accounting of
4 the uncertainties of this design, because we have got
5 lots of margin. Remember that the core, the minimum
6 water level is about 9 feet above the top of the
7 active fuel. The core is not even uncovered in a loss
8 of coolant accident. There is a lot of margin in this
9 plant.
10 And that is what I was talking about. Why
11 does the core remain covered? As is shown on this
12 chart, this is the ESBWR vessel and this is ABWR
13 vessel, and in the core, you can see that it is lower
14 in the vessel of this plant.
15 And when you have a bigger vessel, you
16 have got actually more water. What you want to do is
17 have a lot of water above the top of the active fuel.
18 So one of the reasons that you have got water by the
19 top is that it is going to be less.
20 MEMBER LEITCH: One of the features of the
21 present design, the present fleet with the jet pumps
22 is that you have two-thirds core coverage even with a
23 LOCA.
24 Now in this situation, you don't really
25 have any ensuring of core coverage with a LOCA, just

1 depending on the fact that you have few and smaller
2 lines below the core?
3 MR. RAO: No, this one is a lot better
4 than any other plant, period, because you can fill up
5 -- let me go back to a question from before. Well,
6 that one is a new one. This is as good as any, and it
7 shows the answer.
8 What happens is that you can fill up the
9 lower drywell in the vessel to the top of the active
10 fuel, about two-thirds correct, to the top of the
11 active fuel. It is a closed system, and so you will
12 always keep that core covered.
13 It doesn't take any fancy calculation.
14 You just take all the breaks and the water flows from
15 there, and what has happened in this plant is this
16 lower drywell volume is only 700 cubic meters, okay?
17 The lower drywell volume in all these
18 plants is huge. You can't flood the outside, okay?
19 So you can talk about filling it up to two-thirds of
20 core height, but the outside is empty.
21 On this one, not only is the inside full,
22 but the outside is all full of water. So you are
23 assured of core coverage on this one.
24 MEMBER WALLIS: As long as you remove the
25 heat?

1 MR. RAO: Yes, decay heat removal goes out
2 through those passive heat exchangers. I mean, there
3 is no moving parts there. I know that I am not giving
4 you a convincing answer.
5 MEMBER LEITCH: I have to think about it
6 for a little bit. Go ahead.
7 MR. RAO: You know, if you just look at
8 this, this is drawn to scale. This is only 700 cubic
9 meters down here to the top of that. And that is a
10 thousand cubic meters over there and that pool is not
11 showing up there.
12 MEMBER LEITCH: Yes, but you are relying
13 on a safety system to fill it up?
14 MR. RAO: Well, that is how you keep two-
15 thirds core in the operating plants, too. You have a
16 safety system. The safety system is the gravity
17 driven pool. That's all it is. It is not anything
18 more complex than that.
19 So what you see in this plant is the water
20 volume that is a true measure of how well this plant
21 behaves, you have got about 2=to-2-1/2 times as much
22 water as any of the operating plants.
23 MEMBER LEITCH: In the vessel.
24 MR. RAO: In the vessel, yes. And the
25 other thing is that not only do you have more water,

1 but you have got a larger steam volume. Remember that
2 I mentioned this, that you have and 80 percent void in
3 the chimney.
4 So when you get a reactor isolation, the
5 transient response is a lot better. You have got
6 twice as much steam volume, and so you have got about
7 half the pressure rate in the standard operating
8 plant.
9 This shows what happens to the water.
10 Initially, the water -- this is from a TRACG
11 nodalization, and initially the water is on the
12 outside of the stand pipes, and the downcomer, and in
13 the core region.
14 The chimney is voided, and when you get to
15 reactor isolation, this water basically comes down and
16 fills out the downcomer, and fills up the chimney
17 region. And that fills up the water level to about 8
18 meters.
19 So that's how much water there is in the
20 vessel. There is a lot of water. This shows the
21 plant response, comparing different plants. You can
22 see that the ESPWR has a lot more margin than past
23 plants.
24 This is the water level above the top of
25 the active fuel following a pipe break. The jet pump

1 plants, I was more generous to them, and showed them
2 recovering from the top of the active fuel, rather
3 than two-third core height.
4 And the ABWR doesn't uncover, because it
5 does not have any large pipes, and recovers because
6 you inject water. And these have to be done in the
7 100 or 120, or 200 seconds. Very fast. Some of the
8 earlier plants were a lot faster than that.
9 In this plant, the water level initiative
10 drops because the water comes from outside the shroud
11 and into the core region, and so that is why you see
12 a drop in the water level.
13 Then you get flashing and
14 depressurization, and then the water level slowly --
15 it takes about 600 seconds before you get to the
16 minimum water level, and that is when the water starts
17 flowing in by gravity. The pressure is lower enough
18 in the vessel and it starts running water makeup, and
19 it does not recover as fast. These ones come back
20 really fast.
21 This one, because the gravity flow is not
22 as fast, it doesn't need to come up any faster, but
23 the core is still covered. So what it shows is that
24 this plant is a lot more forgiving, and the other
25 thing to notice is that when we went out from SBWR to

1 ESPWR, we actually improved the response.

2 So it is not just a power uprate where you

3 lead into the margins. We have actually retained them

4 the margins that we had, and maybe got a little

5 better.

6 So this is a picture of some of the

7 hundreds of pages that I keep mentioning that we

8 submitted to the staff to basically give us approval

9 that we know how we calculate the plant response out

10 here. It is reasonable, and some of this stuff can be

11 done in the back of an automobile.

12 But this does give us confidence that what

13 we are getting out the code is good. Where we are on

14 the overall status, and I am down to my last two

15 charts, is we had made extensive submittals to the NRC

16 in 2002, and we had several meetings and conference

17 calls interactions, and in fact we met yesterday and

18 we met this morning.

19 The NRC staff has done an extensive and

20 thorough review of about 300 plus RAIs, and a few more

21 that are coming fairly shortly. According to the

22 plan, final responses by GE are due by August 15th,

23 and we will meet those dates.

24 The draft DSER is due mid-October, and I

25 believe it will come back to the ACRS and the thermal

1 hydraulics committee before we get the final safety
2 evaluation report.
3 And we are trying to work out a schedule
4 for additional application submittals governing ATWS
5 stability, and the AOO is sort of in between this
6 submittal and additional RAIs.
7 MEMBER WALLIS: So the big date for you is
8 sometime in October is it? When is the big date for
9 you when we are going to see you again?
10 MEMBER WALLIS: Sometime after October
11 15th, after the draft SER. I think they are trying
12 for sometime in November.
13 MS. CUBBAGE: We are planning for the
14 subcommittee.
15 MEMBER WALLIS: So we have got plenty of
16 time to do our homework haven't we?
17 MR. RAO: It is good summer reading.
18 After that, we will do the preparation of the SAR, and
19 the certification, and we are expecting FDA approval
20 in 24 months after the submittal.
21 And Dana challenged me when I came to the
22 ACRS a few years ago, he says make your submittals and
23 see what the new NRC will do. And by the time that we
24 make the submittal they become 12 months.
25 The charges for the coming month is to

1 make sure that GE responses are timely and complete,
2 and that we get -- they are looking for complete
3 technology closure with no open items.
4 We believe that we have done an extensive
5 program, and we have been responsive to the RAIs, and
6 we believe it is a good complete program. With a 50
7 plus year technology and design program, and this is
8 a BWR with less components that you need to analyze.
9 It is easy to understand the safety
10 response. The analysis is simplified and basically
11 our goal is that this is a program that is made and
12 run by industry and it is not funded by the government
13 or any other organizations.
14 It is an industry-run program, and
15 minimizing the regulatory risks is one of the key
16 factors in going forward with this. And both the
17 company is committed to this, and interested parties
18 are really interested in this design. So, thank you.
19 MEMBER LEITCH: You have not discussed any
20 ventilation systems here. Is that on GE's scope of
21 supply?
22 MR. RAO: No, we didn't discuss the
23 ventilation system. I focused primarily on the stuff
24 that is related to the TRACG approval, and things that
25 were on the table. There is a whole lot of stuff that

1 we did not discuss, such as structures, and materials,
2 and others.
3 MEMBER LEITCH: But when you say there is
4 no diesel, some of those ventilation systems are
5 safety grade systems that need diesels?
6 MR. RAO: No. Remember that the ECCS
7 systems are all inside and they need no cooling.
8 Nothing is needed for those.
9 MEMBER ROSEN: No stand-by gas treatments?
10 MR. RAO: No stand-by gas treatments, and
11 so none of those -- that is the advantage of greater
12 passive systems. You get rid of the whole HVAC, and
13 you get rid of all the water systems. It really does
14 simplify the plant.
15 It is hard to imagine getting something
16 simpler than this. When we did our cost estimate, you
17 will see -- well, we won't share that obviously, but
18 if you order a plant, we could provide you one. But
19 you can see, and I would like to say that we have
20 essentially got the safety systems for free, because
21 what it is, is a few tanks of water, and a few valves
22 connecting them to the vessel.
23 And when you look at the design of the
24 containment, and in fact we were actually planning to
25 reduce the design threshold to even lower than that

1 for the ABWR.

2 But our structure people told us that you

3 don't save anything by reducing the design pressure

4 any further. So we kept it the same as the ABWR,

5 because there are other considerations, like

6 shielding, and just holding up the equipment of the

7 building.

8 MEMBER ROSEN: It would be good to hold it

9 up.

10 MR. RAO: Yes, you have got to hold it up,

11 and so in a sense we have got the containment, and the

12 safety systems for free.

13 MEMBER RANSOM: What is the regulatory

14 risk that you refer to? I mean, just getting it

15 through the process?

16 MR. RAO: Getting it through the process.

17 You can see how long --

18 MEMBER RANSOM: Is there any reason why

19 you think that would be unusual?

20 MR. RAO: Well, we got burned in the

21 earlier days on the SPWR, and I am not trying to find

22 fault with anyone. Like you said, there is enough

23 fault for us, and there is enough fault on the NRC

24 side, or even our sponsor's side, okay?

25 So there we did things in parallel. We

1 have adopted a step-wise approach, which has minimized
2 what we are doing out here. We don't go to the next
3 step until we have a draft SER, and that is what we
4 are trying to do.
5 We won't go to the SAR and certification
6 until we know that we have got testing and the core is
7 approved. We won't go to the COL stage until we have
8 got the draft SER, and the SAR, or the certifications.
9 So that is what we are talking about when we say we
10 want to make sure that we can get closure.
11 MEMBER ROSEN: What about the fuel? Is it
12 the same?
13 MR. RAO: It is the standard fuel. It
14 will be standard. It will keep changing, and the way
15 it works is that basically you use the latest fuel
16 design that is developed. And it has a much shorter
17 cycle life than the vessel in the plant.
18 CHAIRMAN BONACA: Shorter bound.
19 MR. RAO: Yes.
20 MEMBER ROSEN: What do you foresee in
21 terms of plant orders? I mean, or the possibility of
22 plant orders.
23 MR. RAO: We can't get into plant orders,
24 but what we want to do is to be sure that we are ready
25 when the issue comes up, and that is the reason that

1 we started this process obviously, because our feeling
2 was that we need to start getting ready because thee
3 is a lot of stirring and people are showing interest,
4 and we want to make sure that this is the plant of
5 choice.
6 But again you might have heard some
7 presentations at the ANS meeting, where a utility
8 person stood up and plotted a chart of costs versus
9 this. The cost of the X-axis is this, and Y-axis, and
10 made a 9-by-9 block thing, and he put different plants
11 on that.
12 And the ESBWR was on the low cost block,
13 but he had the risk high because we didn't have some
14 of the regulatory approvals. And so that is one that
15 is easy to do. Costs sometimes cannot be fixed, and
16 to come down and you can reduce the risk.
17 So the way the utilities make a decision
18 is cost and risk.
19 MEMBER KRESS: We are talking about
20 economic risk.
21 MR. RAO: Yes, commercial risk. You start
22 on the process --
23 MEMBER KRESS: And you may not every get
24 over it.
25 MR. RAO: But definitely not a safety

1 risk.

2 MEMBER KRESS: I knew that couldn't be

3 right.

4 MR. RAO: An economic risk, a commercial

5 risk.

6 MEMBER KRESS: Yes, commercial.

7 CHAIRMAN BONACA: Okay.

8 MEMBER WALLIS: And this is no letter or

9 anything like that involved?

10 MEMBER KRESS: I can't see any point for

11 a letter at this point, at this time. I think we are

12 just getting our feet wet on this certification

13 process, and it is a good start.

14 I think we know a lot now and know what

15 the process is, and I don't know when the right time

16 for a letter from us is, unless you guys have heard

17 something that you think is pathological about this.

18 MEMBER WALLIS: Well, the thing is, this

19 is a very optimistic and impressive presentation, and

20 it is also that the time scale has not been distorted,

21 and you stayed within your time.

22 And the thing that I just don't know yet

23 is if there are technical issues. If there are some

24 sort of major things that we are going to have to

25 think about. We just don't know yet.

1 MEMBER KRESS: Well, clearly if there are,
2 they would lie in the realm of has there been enough
3 testing to qualify TRACG, and does TRACG do the job.
4 MEMBER WALLIS: That's right.
5 MEMBER KRESS: And I don't think we know
6 enough about the test results. We know a lot about
7 the program now to make a judgment.
8 MEMBER WALLIS: We don't know the quality
9 of the documentation yet.
10 MEMBER KRESS: We have not looked at it
11 very closely.
12 MEMBER WALLIS: And if the quality is too
13 bad, we just won't read beyond page 2 or something.
14 MEMBER SIEBER: Well, the road map is
15 going to be the SER.
16 MEMBER KRESS: I think the SER is it.
17 MEMBER SIEBER: So whatever we do, we are
18 going to do after we see a draft SER.
19 MEMBER WALLIS: Well, we are going to have
20 to look at some documentation before we see the SER.
21 MEMBER SIEBER: That's right.
22 MEMBER KRESS: Oh, yeah, we will have to
23 read some of this, but at this point I see nothing
24 pathological that requires us --
25 MEMBER WALLIS: It is conceivable that

1 some of us in reading the documentation may come up
2 with significant points.
3 MEMBER KRESS: Yes.
4 MEMBER WALLIS: I mean, we don't want to
5 just wait until November.
6 MEMBER KRESS: No, the sooner they know
7 this, the better, if there is such a thing.
8 MEMBER WALLIS: But if we did have points
9 that we need to delve into, can we communicate with
10 the staff?
11 MEMBER KRESS: Yes, definitely. I think
12 it is incumbent on us to get started reviewing the
13 TRACG documentation.
14 MEMBER ROSEN: And how about the test
15 documentation?
16 MEMBER KRESS: And the test documentation.
17 MEMBER ROSEN: How do we get this stuff?
18 Do you make it available to the staff?
19 MEMBER KRESS: We have a CD of it.
20 MEMBER ROSEN: Does it contain all the
21 test reports?
22 MEMBER KRESS: Well, I don't know if all
23 of them are there, but there were a lot of them there.
24 MR. CARUSO: Steve, this is Ralph Caruso.
25 I believe that includes everything. Everything that

1 the staff has, all the members have. It is all on
2 that CD.
3 MEMBER ROSEN: Okay.
4 MR. CARUSO: I understand that there are
5 some members that have a problem opening some files,
6 and we will talk to you about that. We will figure
7 out how to deal with that.
8 MR. RAO: And that is a 400 page report on
9 that valve.
10 MEMBER ROSEN: And it is on the CD, Ralph
11 tells me?
12 MR. RAO: Yes.
13 MEMBER ROSEN: I have not opened the CD or
14 even tried yet. But I will.
15 MEMBER SIEBER: I did.
16 MEMBER KRESS: Unless you guys have got
17 more to say, I guess I will turn it back to you.
18 CHAIRMAN BONACA: Thank you. All right.
19 Thank you very much for the presentation. It was very
20 informative. With that, we will now take a break
21 until 3:00 p.m.
22 (Whereupon, at 2:41 p.m., the meeting was
23 recessed and resumed at 3:05 p.m.)
24 CHAIRMAN BONACA: The meeting is called
25 back to order. The next item on the agenda is the

1 Expert Elicitation in Support of Risk-Informing 10 CFR
2 50.46, and that is -- I see here Dr. Shack.
3 MEMBER SHACK: Well, as most of you are
4 aware, there was certainly an effort to develop a risk
5 informed alternative to the present maximum LOCA break
6 size, and the staff is looking at ways to characterize
7 LOCA frequencies.
8 I think eventually we will have an SRM
9 that directs you to a reconciliation of LOCA frequency
10 distributions based on service data, probablistic
11 fraction mechanics.
12 And since one has a very, very --
13 fortunately one has a very weak database for large
14 break LOCA events, expert elicitation to somehow
15 converge the results and get some handle on it. And
16 they are in the midst now of their expert elicitation,
17 and Robert Tregoning is going to give us an update of
18 how they are going about the expert elicitation.
19 And we have a number of very elicit
20 members who are highly experienced in this arcane art.
21 MR. TREGONING: That is what I am banking
22 on.
23 MR. NEWBERRY: Before Rob gets going, I am
24 Scott Newberry from the Office of Research, Risk
25 Assessment staff, and Rob's presentation, like Dr.

1 Shack said, is focused on the expert elicitation of a
2 much larger activity to risk-informing 10 CFR 50.46.
3 And as was indicated, there is a recent
4 March SRMs which many of you may have read. It is
5 quite an SRM, and I think I just wanted to put some
6 context on the briefing here.
7 There is considerable activity wrapping up
8 now as a result of the SRM. Eileen McKenna is here in
9 case you have questions or thoughts on the rule
10 making, which is beginning to pick up as I said.
11 So there are staff on the NRR working on
12 all aspects of the rule, as is my staff in research.
13 And all three divisions are thinking about what a rule
14 would look like.
15 The industry is working as well. There
16 was a meeting just here this last month with licensees
17 and NEI, where they are thinking of submitting
18 material that would relate to other aspects of the
19 rule, and considerations of the loss of off-site power
20 requirement in the rule.
21 And these interactions will proceed. So
22 I just wanted to comment that there is a lot of
23 aspects going into 50.46. Eileen and Hossein are here
24 in case the committee wants to ask a question that
25 might be outside of Rob's area. He is focusing on the

1 expert elicitation and I am sure that we are going to
2 be here quite a few times talking about all of these
3 aspects. So we are glad to be here.
4 MR. TREGONING: Thanks, Scott. As both
5 Scott and Bill mentioned, it is a very broad and
6 challenging effort that the Office of Research and NRR
7 are undertaking, and today we are really looking at a
8 piece of that effort.
9 It is a piece that we have been looking at
10 for quite some time, and so technically we have been
11 thinking about it for a while, and we have been
12 planning and developing issues and frameworks, and
13 things like that, to deal with the specific issues.
14 So this seemed like a really opportune
15 time given where we were in the schedule, and given
16 people's interest, to come in and discuss at least one
17 very important technical phase in the project.
18 Certainly not the only, but one of the
19 necessary technical phases in the process, and this is
20 an expert elicitation that we are conducting in
21 support of this broader effort to look at
22 redevelopment of a full spectrum of LOCA frequencies
23 that we would use to support this risk-informed
24 reevaluation effort.
25 So I don't want to forget Lee, who is also

1 here. So any messy statistical or elicitation
2 questions, I am just going to cede the floor at that
3 point, and maybe duck into the hallway get Lee up here
4 to answer those.
5 So I will be fielding any easy and general
6 questions and any specific questions, Lee is back here
7 to handle the really tough ones. Just an update of
8 what you all have heard just to refresh everyone's
9 memories, and what's happened since the last briefing?
10 The last time we came in to talk about
11 this was a little over a year ago, May of 2002. This
12 was a combined subcommittee meeting, Materials Thermal
13 hydraulics and the PRA folks, and we told you about
14 the interim LOCA frequency elicitation effort that we
15 had recently finished.
16 This first effort was in support of the
17 ECCS reliability-feasibility study that was really one
18 of the initial components that kicked off the 10 CFR
19 50.46 effort. So we focused primarily on this interim
20 solicitation, and how we conducted it, and what the
21 results were.
22 But we also gave you some of the broader
23 plans that we had at the time for redefining the LOCA
24 break size. We discussed conceptually at least the
25 elicitation, and I got some good feedback from ACRS at

1 the time.

2 We certainly tried to incorporate and

3 implement as much of that feedback as had been

4 possible. So this was really a good fundamental

5 building meeting that we had last year.

6 But really even prior to last year, we

7 have been talking about and thinking about this all

8 the way back, a couple of years back, back in March of

9 2001, when I think we were first here talking about

10 the technical reasons of why we needed to go about

11 doing this LOCA reevaluation.

12 So what has happened since May 2002, and

13 I am just going to highlight a couple of the

14 milestones right now, and we will certainly go into

15 much more detail about all of these milestones

16 throughout the presentation.

17 But some of the more significant things.

18 We have actually selected our expert panel and

19 facilitation team that are going to be conducting and

20 participating in the elicitation.

21 We have had the kick-off meeting for the

22 elicitation effort. This was February 2 through 4 of

23 this year. Again, these are roughly chronological

24 order. So this was done in about November, and this

25 was in February.

1 As Scott mentioned, in March, we had the
2 SRM issued on the Option 3 plan for risk informing 10
3 CFR 50.46, Appendix K and GDC-35, of which the LOCA
4 redefinition was one of four pieces of that.
5 And certainly a focus of the SRM, if you
6 look at the SRM, as many of you have, even though LOCA
7 redefinition is only again 1 of 4 of the areas that is
8 being evaluated in this risk-informed reevaluation, it
9 occupied about 80 to 90 percent of the SRM, with a lot
10 of very specific direction from the Commission.
11 So the Commission has obviously some very
12 strong view points and very detailed view points on
13 how we needed to proceed in this area. So this was an
14 important milestone, and it focused to reevaluate the
15 plans that we have up until now, and to make sure that
16 we have incorporated the Commission's direction within
17 those plans.
18 After that, we have had a second meeting
19 with the expert panel and the facilitation team, where
20 we reviewed some interim results that we had, and this
21 was really a final meeting before we go into the
22 elicitations themselves.
23 We had this meeting -- this was a two day
24 meeting that was held last month, the first week in
25 June, and then finally since then, and this is again

1 a broader meeting, and we had a broader public meeting
2 to discuss the 10 CFR 50.46 effort.
3 This was a little bit -- a couple of weeks
4 after this meeting, and the elicitation was also
5 discussed there. So a lot has happened since the last
6 time that we were here.
7 MEMBER WALLIS: This public meeting, did
8 you have many representatives other than industrial
9 people?
10 MR. TREGONING: We had one didn't we?
11 Anybody other than industry at the public meeting;
12 didn't we have one? It was primarily NEI and the
13 owners groups.
14 MEMBER WALLIS: Because I would think that
15 any revision of the LOCA definition would be of
16 interest to certain sectors of the public.
17 MR. TREGONING: That public meeting was
18 broader than that. It was the 50.46 effort in
19 general. So with that meeting, we only briefly
20 touched on the elicitation effort. Maybe a couple of
21 minutes in the meeting.
22 It dealt more with the SRM in general, and
23 what the framework of --
24 MEMBER WALLIS: So the timing isn't right
25 for the public to get involved?

1 MR. TREGONING: Well, once we get a little
2 bit further on the elicitation, there will certainly
3 be some more public meetings dealing specifically with
4 that.
5 So let me summarize where we are at, and
6 again we will get into more detail on all of these,
7 but I just wanted to pick some of the big picture
8 bullets here of where we are at in the elicitation,
9 and we will get into a lot of these in much more
10 detail as we go.
11 But at least -- and this one is my
12 opinion, and I hope that it is management's opinion,
13 and hopefully ACRS opinions at the end of the day, but
14 I really feel like the elicitation objective and the
15 approach that we are following is consistent with the
16 guidance that we got in the SRM for the development of
17 LOCA frequencies.
18 And I use the term near-term here, because
19 if you look at the SRM, and I will put some of the
20 salient features up from the SRM in a minute, they
21 talk about looking only for the next 10 years or so.
22 So that is what I mean when I say in the near term,
23 sort of now and into the near future for these LOCA
24 frequencies.
25 The elicitation effort is structured in

1 such a way that we will get LOCA frequencies as a
2 function of leak rate and operating time. Leak rate
3 is important. We are looking at the full range of
4 LOCAs, and now just LBLOCAs.
5 We think that it is important from a risk
6 base not to look at just absolute values, but
7 relatively how these different break sizes compare.
8 So we think we would be remiss if we looked at a
9 reevaluation of just the LBLOCA frequency, or LBLOCA
10 regime, and then neglected the small break and medium
11 break, because we would not have a consistent
12 comparison at that point.
13 So we are looking at the full range, and
14 we are looking at it as the function of an operating
15 time, and we are considering both piping and non-
16 piping contributions to these LOCA frequencies.
17 And both implicitly and explicitly looking
18 at considerations or contributions from all modes of
19 plant operations.
20 MEMBER WALLIS: And the wrong piping would
21 be something like the Davis-Bessie event?
22 MR. TREGONING: Yes.
23 MEMBER WALLIS: I think you won't have
24 difficulty if you come up with a conclusion that that
25 was a very unlikely event.

1 MR. TREGONING: Well, if you look -- one
2 of the big challenges in LOCA estimation in general is
3 that it is always the -- that the surprises are the
4 one-time events and are the things that make provide
5 the biggest challenge at the end of the day.
6 And we have had a lot of discussion among
7 the panel about that, and that it is not always the
8 things that you know about. It is the things that you
9 don't know about that are really the significant
10 contributors.
11 MEMBER KRESS: I think it was an unlikely
12 LOCA.
13 MEMBER WALLIS: Well, there was a leak.
14 You know what I am getting at.
15 MEMBER KRESS: You are referring to the
16 large break LOCA.
17 MR. TREGONING: I know what you are
18 getting at, and we have done some work and had some
19 discussion among the panel at going back over the
20 operating experience and looking at similar one-time
21 surprise mechanisms, things that have happened once
22 that we don't expect, and we have good reason to
23 expect won't happen again.
24 And to try to provide some rational
25 assessment of their frequency and potential severity.

1 It is not an easy thing to do. I don't want to say
2 that it is. And it is certainly a big challenge in
3 this project. But we have certainly talked about it.
4 MEMBER POWERS: Maybe you will get into
5 this later, but I am puzzled. If you have something
6 actually that occurs that is unexpected, and suppose
7 we put that in a class of unexpected things, stuff
8 that happens.
9 And we ask a Baysian how likely is it that
10 unexpected stuff will occur that has a high potential
11 of leading to a large break LOCA, and you come up with
12 a pretty high number don't you?
13 And you can argue perhaps to me that TMI
14 will never occur again, but you can't argue to me that
15 small break LOCAs never occurs again. You can argue
16 to me that erosion of a hole in the head by boric acid
17 will not occur, but it is difficult to argue to me
18 that something of similar surprising character will
19 never occur again.
20 And you will be glad to provide us with
21 lists of things that degrade materials.
22 MR. TREGONING: Of course, and what we
23 have tried to do in this exercise, at least again very
24 explicitly, is to look at the -- and I will get into
25 this in more detail, but to look at the areas within

1 the plant that are LOCA sensitive.

2 Think about the systems, and think about

3 the degradation mechanisms that could occur. Think

4 about the loading that could occur, both typical and

5 surprise,a nd try to consolidate all that information

6 and make an assessment as to how likely you think that

7 those specific sets of conditions are.

8 And given the likelihood that they occur

9 how severe they will be after the fact.

10 MEMBER POWERS: Well, doesn't the Baysian

11 estimate give you a floor under your frequency?

12 MR. TREGONING: The thing with the Baysian

13 estimate, what you can do easily I would grant you, is

14 that you can add all of the surprise mechanisms that

15 you have had in your PI and get a frequency of

16 surprise mechanisms.

17 What is harder is finding the conditional

18 LOCA severity for those given surprise mechanisms. I

19 can say that with pretty good certitude because we are

20 trying to analyze Davis-Bessie now for almost a year,

21 and we have put a lot of time and resource into it,

22 and I think we are finally coming closer now to

23 understanding or having an assessment which is

24 somewhat realistic.

25 But I don't know that every event has

1 received that same scrutiny or it is even possible.

2 MEMBER WALLIS: Well, to go on now, both

3 TMI and David-Bessie had human behavior aspects, and

4 I am not quite sure how you are going to take account

5 of that in your studies.

6 MR. TREGONING: Hopefully that will come

7 out later. I do talk about that, and we get into that

8 in another slide. So I am sure that we will have some

9 more discussion when we get to that point.

10 The other thing that we are looking at is

11 -- and I am calling them emergency faulting, but those

12 one-time loads that are unlikely over the operating

13 history of a plant. Things like earthquake loadings,

14 and very large transients, and very large water hammer

15 transients.

16 We are not trying to analyze their

17 frequencies in the elicitation, but we are trying to

18 say that given this loading what is the conditional

19 LOCA probability.

20 We are specifically avoiding analyzing the

21 frequencies in this effort because there has been

22 again over the history of the nuclear power industry

23 a lot of work looking at analyzing frequencies, and we

24 don't want to supersede that.

25 MEMBER WALLIS: And you are avoiding this

1 one?

2 MR. TREGONING: We are not avoiding it.

3 We are trying to -- what we are trying to do is to

4 provide information or tools that can be combined with

5 that past work to determine the final LOCA

6 probability.

7 MEMBER WALLIS: Does this include

8 sabotage, terrorism, and that kind of thing?

9 MR. TREGONING: What we are doing at this

10 point is again we are defining loadings at a certain

11 magnitude on the pipe. Now how you get that loading

12 could --

13 MEMBER WALLIS: Could be caused by a

14 terrorist?

15 MR. TREGONING: -- be a variety of

16 reasons, okay?

17 MEMBER WALLIS: And that is being

18 included?

19 MR. TREGONING: Again, we are defining the

20 loadings because we are trying to make sure that we

21 have a scope that we can deal with.

22 We have 12 experts, and most of the

23 experts that we have are experts in materials, and

24 they are experts in plant operation, and they are

25 experts in piping, and they are experts in structural

1 mechanics. They are experts in materials.

2 So we need to make sure that we have a

3 consistent framework that the information that we get

4 out also matches their expertise. They are not

5 necessarily experts in terrorist activities, or the

6 likelihood of terrorist activities.

7 So all we are trying to do is to give

8 people a framework that they care comfortable, and

9 that the experts are comfortable with. And this was

10 one thing that we touched on for touching some of

11 these, and again, very unlikely events that could be

12 due to something like an earthquake, like a terrorist

13 event.

14 And one way that the group decided would

15 be the easiest to deal with, and the most consistent

16 with our expertise.

17 MR. NEWBERY: Bob, let me clarify in

18 response to one question. The question was asked are

19 we considering terrorism events here. I think that

20 the staff and the Commission is still looking at the

21 guidance that we need to give on all rule making

22 activities with respect to terrorism.

23 So I think that the answer is -- I would

24 answer it no at this point.

25 MR. TREGONING: Not specifically.

1 MR. NEWBERY: Not specifically, but the
2 SRM certainly has guidance in it relative to that, and
3 how you would implement this rule.
4 MR. TREGONING: The other thing that I
5 would add certainly is that there are other efforts
6 within the agency that are specifically addressing
7 that question, and that is not to say that we would
8 certainly not to leverage against some of that work as
9 we go on here.
10 CHAIRMAN BONACA: But coming back to
11 Professor Wallis' question, the failure of relevant
12 programs to control age mechanisms, for example, is
13 not included in your evaluation. It is strictly
14 engineering.
15 MR. TREGONING: By relevant programs what
16 do you mean?
17 CHAIRMAN BONACA: Well, nothing from
18 preventing the boric acid control program weld at
19 Davis-Bessie.
20 MR. TREGONING: Well, again we look at all
21 of these and you will see when we get into the details
22 that we talk about for each of the degradation
23 mechanisms that we have identified, we talk about
24 mitigation and maintenance procedures that you would
25 use to combat that particular degradation mechanism.

1 CHAIRMAN BONACA: Or preventive.

2 MR. TREGONING: Or preventive. Well, yes,
3 to combat or prevent, and there is certainly an aspect
4 of all these degradation mechanisms where there is a
5 likelihood that they won't be carried out correctly.

6 That they will be carried out incorrectly
7 and the incorrect actions will actually exercebate the
8 problem. So, yes, we will be definitely considering
9 that.

10 And again if you look back over the
11 operating experience like you all had mentioned, and
12 specifically those types of events that are most
13 prominent in terms of the challenges that they give to
14 the system.

15 The elicitation itself, and I will talk a
16 little bit about the philosophy and the way that the
17 elicitation is structured. We are combining aspects
18 of those groups in individual elicitation as we felt
19 it appropriate again to maximize the information that
20 we get out of the experts, and also tailor the
21 elicitation to their strengths.

22 I will talk a little bit about this. It
23 is separate from the elicitation, and I have got this
24 as sort of an aside if we get to it, but we also have
25 plans in place to provide confirmatory analysis for

1 the solicitation, as well as develop a methodology
2 that we can use to continually assess LOCA challenges
3 more rigorously and more robustly as they come up in
4 the future.
5 MEMBER APOSTOLAKIS: What does
6 confirmatory analysis for the elicitation mean?
7 MR. TREGONING: It means that the
8 elicitation will -- that the end result of the
9 elicitation will be essentially LOCA frequencies as a
10 function of break size.
11 MEMBER APOSTOLAKIS: And are you going to
12 confirm that?
13 MR. TREGONING: We would like to confirm
14 that by using some actual modeling, probablistic
15 modeling. And if we get to that -- and the problem is
16 that the probablistic modeling is going to take
17 obviously a while to develop.
18 MEMBER APOSTOLAKIS: But the experts may
19 have already used that model?
20 MR. TREGONING: Many of the experts have
21 used models. There is no such model that is as
22 comprehensive as what we are in the process of
23 developing.
24 We have been working on developing
25 predictive tools in this area for 30 or more years.

1 Bill Shack can give a much better history than me.
2 But they tend to be focused on a few different
3 systems, a few different mechanisms. We have never
4 really tried to combine things.
5 MEMBER APOSTOLAKIS: Why have you guys
6 dropped the word opinion? When you say expert
7 elicitation now, is the elicitation expert, or are you
8 eliciting experts? Shouldn't it be expert opinion on
9 your elicitation, or is it too much --
10 MR. TREGONING: I knew that I was never
11 going to make you happy.
12 MEMBER SHACK: We are on Viewgraph Number
13 4 of 29.
14 MR. TREGONING: Yes. And I will apologize
15 up front if the terminology that I use is confusing.
16 MEMBER APOSTOLAKIS: Shouldn't it be an
17 expert opinion on this thing?
18 MR. TREGONING: Expert opinion? We are
19 trying to get the opinions out of the expert, and me
20 being a non-expert in elicitation terminology, I might
21 offend you with some of the terminology that I have
22 used.
23 MEMBER APOSTOLAKIS: I just make a quick
24 comment.
25 MR. TREGONING: Okay. I hesitated putting

1 this up there, but I figured that I had to do it, and
2 the purpose is not to parse the SRM language, which we
3 could spend the rest of the time that we have doing.
4 But to just put this up there. I pulled out about the
5 five salient points of the SRM that are related to
6 LOCA frequency evaluation.
7 And what I want to do is to use this as a
8 framework for how we think we are meeting this
9 guidance, and I am going to spend most of the talk
10 talking about this, and conducting this practical
11 reconciliation of LOCA frequency distributions by
12 expert use of service data, the SRM, and expert
13 elicitation.
14 This is what Bill used in his opening
15 remarks. As I am talking about this, I want to --
16 MEMBER FORD: Excuse me, but who gave you
17 that first bullet? Was that the instructions that you
18 got from the SRM?
19 MR. TREGONING: Yes, these are from the
20 SRM.
21 MEMBER FORD: Well, who is the technical
22 person who gave you that guidance?
23 MR. TREGONING: Again, it is the
24 Commission.
25 MEMBER FORD: Well, the reason that I am

1 asking the question is that if you take the use of
2 service data from all of the various environment
3 systems that we have in light water reactors, you will
4 have just a random scatter of data. And I fail to see
5 how you will ever make any expert draw any conclusion
6 from that.
7 MEMBER KRESS: That is making sense.
8 CHAIRMAN BONACA: Let's give him a chance.
9 MEMBER FORD: Well, I see nothing there in
10 that 1, 2, and 3. I see nothing at all about the
11 prediction of the time dependent creation of the
12 amount of degradation. There used to be spot checks,
13 and I got a crack of such and such a length after a
14 certain time in some random -- no?
15 And that is how I expect service data.
16 That at a certain time I found a crack in the steam
17 generator.
18 MEMBER SHACK: Well, that is certainly
19 important to know, but it is not to say that between
20 1, 2, and 3 you don't cover that all, Peter.
21 MEMBER FORD: Probablistic fracture
22 mechanics is just mechanics,a nd it does not tell you
23 anything about the creation of the damage.
24 MEMBER SHACK: Sure it does.
25 MEMBER FORD: Sure it doesn't.

1 MEMBER SHACK: It depends on how you do
2 it. If you build it into it, it does.
3 MEMBER FORD: Okay. Carry on.
4 MR. TREGONING: I don't know if I can
5 carry on after that. For most of what we will be
6 doing it will be addressing this point that Peter
7 found so distasteful.
8 MEMBER APOSTOLAKIS: I have a question,
9 too.
10 MR. TREGONING: Sure.
11 MEMBER APOSTOLAKIS: Why do you need to
12 reconcile it? I mean, somebody gives you high
13 numbers, and somebody else low numbers?
14 MR. TREGONING: Of course.
15 MEMBER APOSTOLAKIS: And who does what?
16 MR. TREGONING: It depends. This has been
17 one of the historical problems. You see people coming
18 in and usually using either service data or what they
19 claim to be service data, or probablistic fracture
20 mechanics, where they model something.
21 It is technically the same system. You
22 could get results that are easily -- and I am not
23 making this up, but 10 orders of magnitude different.
24 People laugh, but that is not uncommon. And Peter is
25 shaking his head. That is a common occurrence.

1 MEMBER APOSTOLAKIS: I understand that for
2 materials that is an increase of two orders in PRA?
3 MR. TREGONING: So getting these guys in
4 the same room without killing each other is also a
5 good objective of this expert elicitation.
6 MEMBER APOSTOLAKIS: So the experts then
7 are giving more reasonable results or we don't know?
8 MR. TREGONING: Well, we don't know
9 because they have not given us their results yet. But
10 that is one of the prime reasons that we are doing the
11 elicitation, because of this guidance.
12 MEMBER ROSEN: Can we get off of this
13 slide?
14 CHAIRMAN BONACA: We are on page four and
15 we have quite a ways to go.
16 MR. TREGONING: I will go to 29, and I am
17 happy with that. So we are ready to move on then?
18 Okay, good. This is the general approach that we are
19 using to address the Commission guidance, and we have
20 got essentially a four-prong approach.
21 Again, I am going to focus mainly on the
22 expert elicitation, although I have got a couple of
23 slides at the end that talk specifically about this.
24 I have touched on these already.
25 Again, we are making sure that we have a

1 fundamental and consistent assessment of the operating
2 experience. We have constructed expert elicitation to
3 reevaluate these LOCA frequencies and to develop a
4 relationship between leak rates and break size, and
5 frequency, for all LOCA events.
6 And we are using this not just to give us
7 this relationship, but also to provide some
8 fundamental input that we can use in this computer
9 code development.
10 Why are we doing this? This is our
11 confirmatory analysis. We want to develop I think,
12 and I am not trying to be egotistical, but I think if
13 we are successful, one of the first codes to hopefully
14 combine operating experience and PFM insights
15 together.
16 That is a challenge. It is not easy to do
17 obviously, but that is the goal. That is what we are
18 shooting for. We also within this code, we want to
19 explicitly consider again LOCA contributions to
20 piping, and pmn-piping components, and most
21 importantly look at how merging degradation mechanisms
22 could evolve and what challenges they give to the
23 system.
24 Theoretically if a code was mature enough,
25 something like Davis-Bessie, you would get a hint of

1 it, and if you have got good enough models built into
2 the code, you can assess the challenges much more
3 quickly than we have been able to do with Davis-
4 Bessie.
5 And then the fourth piece is as important
6 as the code development, but making sure that we have
7 tools that we can do a continual assessment, and one
8 of the things that we are doing here is we are
9 developing LOCA precursor databases, and building on
10 existing pipe failure databases to incorporate also
11 non-piping failure statistics.
12 And of course the other thing that we
13 always try to do in research is identify merging
14 degradation mechanisms and conduct the appropriate
15 anticipatory research to assess the LOCA significance.
16 So the rest of this is going to be focused
17 on that first point that Peter brought up. How are we
18 going to combine these three areas of operating
19 experience, probablistic fracture mechanics, through
20 the detailed solicitation, to give us what we are
21 looking for with this spectrum frequency for both
22 piping and non-piping contributions.
23 MEMBER FORD: And you are going to give us
24 an example of what a formal solicitation will be
25 provided? It will be data, or will it be opinions, or

1 whatever it will be.

2 MR. TREGONING: It will be both, and there

3 will be data and there will be opinion.

4 MEMBER FORD: And there will be

5 algorithms, prediction algorithms.

6 MR. TREGONING: No, not so much. Not the

7 elicitation. WE will assess for each expert how they

8 arrived at their opinions, okay? So they will be

9 describing their predicted algorithms, but an output

10 will not be a predictive algorithm from this exercise.

11 MEMBER FORD: Okay.

12 MR. TREGONING: It is important to

13 understand how people are arriving at their opinions.

14 MEMBER FORD: I agree.

15 MR. TREGONING: I think that we have

16 caught a lot of this --

17 MEMBER SHACK: Why don't you just skip

18 ahead to nine so just we know what you are doing on

19 your elicitation.

20 MR. TREGONING: Okay. That's fine. The

21 formal approach to the elicitation, and these are the

22 6 or 7 steps that we are following, and I am going to

23 go into detail on each of these.

24 We have selected the panel and the

25 facilitation team, and we have developed technical

1 issues that we want to address, and that includes
2 defining the scope and objectives, and constructing
3 the approach, and determining significant issues.
4 We have put a lot of work into quantifying
5 these base-case estimates, and I have a lot of
6 discussion on what these are and why they are
7 important within the framework of the elicitation.
8 Essentially, they are going to be
9 quantitative estimates for well-defined piping
10 conditions. And we will have four sets of estimates,
11 two using primarily PFMM modeling and two using
12 analysis of service history.
13 But they will be benchmarked to the same
14 service history data.
15 CHAIRMAN BONACA: You mean, two estimates,
16 and you will have two separate teams providing
17 estimates regarding the same set, or --
18 MR. TREGONING: We have four different
19 people from the expert panel.
20 CHAIRMAN BONACA: All right. Okay.
21 MR. TREGONING: We have developed the
22 conditions from the whole group. The whole group
23 defined how the analysis or what the analysis should
24 try to -- what the objectives should be and the
25 results should be.

1 The four people went off and they
2 collaborated, and so in a sense they acted as a group
3 so that they knew that they were using the same set of
4 operating experience data.
5 And then what you will see at the end of
6 the day is that they will come back, and that is that
7 follow-up meeting that they had and presented their
8 results to the expert panel.
9 MEMBER POWERS: When you speak of
10 operating data, are you speaking only of nuclear
11 powered systems, or are you also considering other
12 systems?
13 MR. TREGONING: Nuclear. We are only
14 looking at the nuclear experience.
15 MEMBER APOSTOLAKIS: Worldwide?
16 MR. TREGONING: Worldwide, but obviously
17 we are heavily focused on the U.S. But obviously the
18 databases that we look at and the insight that we have
19 is also pulling in the worldwide experience, and three
20 of the panel members that we have are from overseas.
21 So we also get worldwide experience in that regard.
22 MEMBER POWERS: Is there a reason that you
23 have excluded fuel plant experience?
24 MR. TREGONING: There is many reasons.
25 The materials are quite a bit different, and the

1 operating experiences are different. I would just
2 personally say that they are not consistent enough to
3 try to combine those together.
4 If we did, fossil plants have had LBLOCAs.
5 So I don't know that we would want to do that.
6 MEMBER SHACK: You mean the failure
7 mechanisms are quite different.
8 MR. TREGONING: Yes.
9 MEMBER SHACK: And if you have grade
10 failure of an axial weld seam in a cold fire plant,
11 that has absolutely no relevance to it.
12 MR. TREGONING: And that has been a
13 degradation mechanism that has led to LBLOCAs in --
14 MEMBER WALLIS: Now, pipes have failed in
15 nuclear plants from thermal fatigue.
16 MR. TREGONING: Yes.
17 MEMBER WALLIS: And I don't see anything
18 here about thermal. It seems to be all probablistic
19 mechanics people. Yet the cores could well be
20 something that is quite different.
21 MR. TREGONING: Well, again, we have a
22 number of piping system and plant experts on this
23 panel that know about thermal fatigue loading and have
24 experience dealing with thermal heat cracking in surge
25 line primarily, and feed water nozzle and things like

1 that.

2 But I am purposely not talking about

3 specific degradation mechanisms, but if you look at

4 the mechanisms that we have talked about, thermal

5 fatigue is quite prominent and quite an important one.

6 MEMBER WALLIS: Yes.

7 CHAIRMAN BONACA: Now here you must have

8 also used the definition of a LOCA.

9 MR. TREGONING: Yes, and I am going to get

10 to that, too.

11 MEMBER FORD: But you are identifying

12 specific code regulation notes?

13 MR. TREGONING: Of course. We would be

14 remiss if we didn't.

15 MR. GILLESPIE: I thought you just said

16 now that you weren't.

17 MR. TREGONING: I was not going to

18 identify them in this talk. You won't see them in

19 this talk unless you all ask about them.

20 MEMBER FORD: Could I ask?

21 MR. TREGONING: Of course. Yes.

22 MEMBER FORD: Well, could you just quickly

23 tell us what the degradations are that you are

24 considering?

25 MR. TREGONING: Well, essentially anything

1 that we think is relevant. We have gone through every
2 LOCA sensitive piping and identified the materials and
3 degradation mechanisms which are relevant.
4 And they include the whole ball of wax,
5 from fatigue, corrosion, corrosion of any vain, IGSCC,
6 PWSCC, trans-granule or external stress, and chloride
7 cracking and corrosion.
8 We have looked at boric acid corrosion,
9 and we have talked about thermal fatigue, and
10 mechanical fatigue, more high cycle vibratory fatigue.
11 A whole host of things. Any fact, of course, is
12 important.
13 All the things that people classically think about.
14 MEMBER FORD: Well, this is a fairly high
15 level approach then, because from those that you
16 mentioned, there is no way of predicting it.
17 MR. TREGONING: I am going to show you the
18 approach and I think you will have a really good sense
19 of where we are going once you see the approach. The
20 other thing we do is formulate the questions.
21 If you look at where are at on the
22 schedule, we are up to about here. We are still doing
23 some little tidying up work in this area, and we
24 formulated our questions, and we are getting ready to
25 start conducting the individual elicitations.

1 MEMBER APOSTOLAKIS: There was an
2 important bullet on the previous slide that we
3 skipped.
4 MR. TREGONING: Which slide is that?
5 MEMBER APOSTOLAKIS: You are educating the
6 experts as a group, but you are eliciting
7 individually.
8 MR. TREGONING: That's correct.
9 MEMBER APOSTOLAKIS: That is a key element
10 here.
11 MR. TREGONING: Yes.
12 MEMBER APOSTOLAKIS: So that everybody
13 comes to the same understanding of the issues, but
14 then you have individual --
15 MR. TREGONING: Yes.
16 MEMBER APOSTOLAKIS: Are you going to show
17 us the names of the experts?
18 MR. TREGONING: I was not going to show
19 you the names, but I will tell you the names.
20 MEMBER APOSTOLAKIS: Okay. When?
21 MR. TREGONING: Are you asking for them
22 now?
23 MEMBER APOSTOLAKIS: Are we? Yes.
24 MR. TREGONING: Would you like their
25 affiliations, too? Bruce Bishop of Westinghouse; Vic

1 Chapman, formerly of Rolls Royce; Gary Wilkowski, of
2 EMC Squared, formerly of Bechtel; Guy Deboo, who is
3 with Exelon; Sam Ranganath, formerly of GE; Pete
4 Riccardella, from Structural Integrity Associates.
5 Let me think. Karen Gott from SKI; Helman
6 Schulz of GRS; David Harris, and Bengt Lydell of Aaron
7 Engineering; and Bill Galyean of INEEEL. I think that
8 is it. And Fred Simmon of INEEL. We have Exelon and
9 Westinghouse.
10 MEMBER SHACK: But Westinghouse was not a
11 utility person the last time I checked.
12 MR. TREGONING: Well, industry
13 participation.
14 MEMBER SHACK: Well, Guy Deboo is
15 industry. He is a utility.
16 MR. TREGONING: Exelon, yes.
17 MEMBER APOSTOLAKIS: Graham, do you
18 recognize any names that would be an expert on the
19 thermal fatigue --
20 MEMBER WALLIS: You have no academics?
21 MR. TREGONING: We have no academics.
22 MEMBER WALLIS: No one to keep you honest?
23 These are all people wrapped up in the nuclear
24 business?
25 MR. TREGONING: Yes.

1 MEMBER WALLIS: Seriously.

2 MR. TREGONING: Yes.

3 MEMBER SHACK: But only one of them an

4 owner, with any kind of owner perspective. Like owner

5 of these assets.

6 MR. TREGONING: I would argue that

7 Westinghouse, and Exelon, and GE, have similar

8 perspectives.

9 MEMBER WALLIS: Now I think that this

10 could be a contentious list for a public forum

11 eventually. You are going to have to defend the --

12 MEMBER SHACK: Why don't you go to your

13 next slide which discusses the panel selection.

14 MR. TREGONING: Yes, we spent a lot of

15 time on the panel. It is not easy to do obviously.

16 MEMBER APOSTOLAKIS: So the academics were

17 not selected is what it says.

18 MR. TREGONING: We looked at people from

19 across the board, there is no doubt, including

20 academia. The difficulty with this panel is because

21 of the range of technical specialties that are

22 required, we were really looking for broad-based

23 people, because we wanted the most well-founded panel

24 we thought we could get. These are not all the

25 specialties that we looked for, but these are some of

1 the primary ones.

2 We eliminated a lot of very good people

3 who we thought were too narrow, because we were

4 looking for people that were, again, who had broad

5 experience in a lot of relevant technical areas.

6 Because again what we were trying to do

7 was in general boost the overall knowledge of the

8 panel itself and keep it very broad so that the

9 discussions could be fruitful.

10 If we had a bunch of specialists, and we

11 had one specialist in each area, we never would have

12 gotten anywhere I don't believe.

13 MEMBER APOSTOLAKIS: Who is your

14 facilitation panel?

15 MR. TREGONING: The facilitation panel is

16 myself, Lee Abramson, Alan Kuritzky, Bennett Brady and

17 Paul Scott of Bechtel; and Ken Jaquoy of -- he is

18 formerly an industry consultant, and now independent

19 consultant.

20 MEMBER APOSTOLAKIS: Except for Lee, has

21 anybody else been involved in a elicitation?

22 MR. TREGONING: I don't think so.

23 MEMBER APOSTOLAKIS: This agency has

24 sponsored major efforts in the past, especially in the

25 seismic area, and couldn't you get one of those guys

1 to participate as a facilitator?

2 MR. TREGONING: Well, when we picked the

3 facilitation team, we wanted to make sure that we had

4 substantive experts that matched these fields also.

5 MEMBER APOSTOLAKIS: And normative.

6 MR. TREGONING: Right, and Lee is our

7 normative expert.

8 MEMBER APOSTOLAKIS: And so he is the only

9 one?

10 MR. TREGONING: Right. So, yes, we could

11 have, but we did focus on making sure that we had

12 appropriate substantive experts. Do you disagree?

13 MEMBER WALLIS: Well, I am just baffled by

14 the whole idea that there are normative and

15 substantive experts. but go on.

16 MEMBER APOSTOLAKIS: Normative is a guy

17 who is familiar with the process, and the issues

18 related to the process of what you should be, and what

19 the pitfalls are. You look at Lee. This is a guy.

20 MR. TREGONING: But you don't have to

21 define it. Just look at Lee.

22 MEMBER APOSTOLAKIS: And substantive guys,

23 these are stress analysts.

24 MEMBER WALLIS: People who know something,

25 right?

1 MEMBER APOSTOLAKIS: And know something
2 about the subject itself, but not the process
3 necessarily.
4 MEMBER ROSEN: I am astounded and entirely
5 dismayed by the idea that you have so few of the asset
6 owners on this, and you said that industry includes
7 them. And let me give you an analogy.
8 If you were about to constitute an expert
9 panel on some issue of great significance to the
10 airline industry, and had no one representing the
11 airlines, or one person representing the airlines, I
12 think that a priority would be to discount the answer.
13 What is your response to that? How could
14 you have possibly put this together this way?
15 MR. TREGONING: The expert panel, and the
16 panel was known to people in the industry, and we also
17 solicited names from the industry.
18 MEMBER WALLIS: That's the problem.
19 CHAIRMAN BONACA: No, I don't think it is
20 a problem. Wait a minute now.
21 MR. TREGONING: Do you have a suggestion
22 of either a person or an entity?
23 MEMBER ROSEN: Give me 30 seconds and I
24 would, sure.
25 MEMBER KRESS: Are you implying that these

1 experts are biased in their opinion?

2 MEMBER ROSEN: Of course, I am. It is not

3 only implying, but I am suggesting that they should.

4 That is exactly what experts do. They come to the

5 question with their biases from their experience and

6 points of view.

7 CHAIRMAN BONACA: Well, I would expect

8 that people from Westinghouse or GE, which really

9 relate all their work to a real class of plants, et

10 cetera, would in fact have more insight of plant

11 specific individual companies.

12 MEMBER ROSEN: I disagree.

13 CHAIRMAN BONACA: And who deal with pipe

14 systems for a full generation of plants, and they deal

15 with all the utilities and all the problems that they

16 have. So I personally think that there is sufficient

17 representation there for the industry, insofar as

18 expertise to have this kind of elicitation.

19 MEMBER ROSEN: I disagree respectfully of

20 course, Mr. Chairman.

21 CHAIRMAN BONACA: Yes, I understand. And

22 I respectfully disagree with your point of view. I

23 think that --

24 MEMBER SHACK: And you basically have the

25 consultants that the industry typically hires to

1 handle a problem like this. I mean, the first guy you
2 call is Riccardella.
3 MEMBER ROSEN: Of course, but that has
4 nothing to do with the constitution of this panel.
5 And I have already said my point of view, is that if
6 you were an airline that you would have some people at
7 the end of the operating chain, the food chain, who
8 would be part of this process and who could later on
9 say, yes, I was part of it and I agree, or this makes
10 sense overall. They have not done that.
11 MEMBER APOSTOLAKIS: Well, when it says
12 operating mitigation practices, do you think that the
13 current panel members are very familiar with those?
14 Is that the expertise of the utility person would
15 have?
16 MEMBER ROSEN: Well, yes, that is one thing
17 for sure.
18 MEMBER SIEBER: Those would be things like
19 chemical treatment and those are developed by the
20 vendors.
21 MEMBER ROSEN: Off normal circumstances
22 that occur.
23 MEMBER SIEBER: I don't find that
24 offensive.
25 MEMBER APOSTOLAKIS: Defensive.

1 MEMBER ROSEN: Offensive.

2 MEMBER APOSTOLAKIS: Oh, offensive.

3 MEMBER SIEBER: I am not offended.

4 MEMBER APOSTOLAKIS: Because the way you

5 were speaking and sitting down --

6 MEMBER SHACK: Well, we are on Slide 10 of

7 29, and we are heading towards four o'clock. So maybe

8 we will just register that note and move on.

9 MEMBER KRESS: That would be unusual

10 wouldn't it?

11 MEMBER SHACK: I think we can have mixed

12 opinions int he panel as to whether it is a problem.

13 MR. TREGONING: As we move through the

14 process, we certainly will be getting feedback, and

15 the feedback will be welcome, as it always is, from

16 all sources. So if we get some feedback that causes

17 us to go back and revise some of these things for very

18 good reasons, we are certainly open.

19 This is not a closed process and it is not

20 a process necessarily that when we are finished and

21 the panel comes in with the final result that it is a

22 done deal.

23 MEMBER ROSEN: I understand that you are

24 not offended if I don't like your process.

25 MEMBER FORD: Bill, I don't know how you

1 feel about this, but it seems to me though that this
2 topic is of such importance that it should be done
3 correctly. I am ont saying that it is not being done
4 incorrectly, but there is obviously a lot of --
5 MEMBER SHACK: Can I disagree with that,
6 Peter?
7 MEMBER FORD: Well, there is a lot of
8 opinions around the table. I think that before too
9 long there should be another try committee, M&M
10 thermal hydraulics subcommittee meeting for a day and
11 discuss this.
12 Once you have got some more or have moved
13 off the starting block, then --
14 MEMBER SHACK: Well, they are off the
15 starting block.
16 CHAIRMAN BONACA: They are already down to
17 the 5th or 6th bullet.
18 MEMBER SHACK: But perhaps we should think
19 about a subcommittee meeting here, but we are moving
20 or they are moving right along. They have a schedule
21 to meet.
22 MR. TREGONING: SEM is aggressive and so
23 we have no choice.
24 MEMBER SIEBER: I suggest that we do that
25 here, too, and move right along.

1 MR. TREGONING: Okay. We covered the
2 first bullet and the next thing I am going to look at
3 is how we develop the technical issues. We have
4 talked a little bit about this already. The first
5 thing we looked at was developing the scope and
6 objectives for the panel.
7 Again, I have brought this up many times,
8 but again we are developing piping and non-piping
9 passive system LOCA frequencies as a function of
10 creating an operating time, and we are looking up
11 until the end of the license extension period.
12 MEMBER WALLIS: That seems to be to be
13 absurd. LOCA frequency is not a function of leak
14 rate.
15 MR. TREGONING: Why not?
16 MEMBER SHACK: Break size.
17 MR. TREGONING: Break size. But break
18 size has been built on leak rate historically if you
19 go back to 11-50. The leak rate determines the plant
20 responses.
21 CHAIRMAN BONACA: And I asked the question
22 before the definition, and I am sure that you will
23 give it to me, but really what I had in my mind before
24 was like an event at VCsummer, where you had a leak,
25 and would it be part of your database that you have to

1 look at?

2 MR. TREGONING: Yes.

3 CHAIRMAN BONACA: And I imagine it would

4 be, right?

5 MR. TREGONING: Of course.

6 CHAIRMAN BONACA: I would like to know how

7 it gets to be into that given that the definition of

8 LOCA is one that --

9 MEMBER SHACK: Any precursor that could

10 lead to a LOCA is obviously --

11 MR. TREGONING: That is a precursor event.

12 MEMBER SHACK: His LOCA database is very

13 sparse.

14 CHAIRMAN BONACA: I can wait on the

15 question.

16 MEMBER SHACK: One or two, and we would

17 not need to be here anymore.

18 MR. TREGONING: That's right. That's

19 exactly right.

20 CHAIRMAN BONACA: Thank you.

21 MR. TREGONING: It is a good thing that it

22 is sparse. We are looking at determining these

23 distributions for the topical plant operating cycle

24 and history,and again like I mentioned, we are

25 estimating conditional probability distributions for

1 these rare events, including seismic and other large
2 unexpected --
3 MEMBER APOSTOLAKIS: Wait a minute. You
4 estimate conditional LOCA probabilities?
5 MR. TREGONING: Yes. I had a bullet on
6 this earlier.
7 MEMBER APOSTOLAKIS: And the experts do
8 that?
9 MR. TREGONING: Yes. The experts would do
10 that.
11 MEMBER SHACK: This is a conditional
12 probability. If you wham it this hard, this is the
13 chance that it is going to bust.
14 MR. TREGONING: They are not experts in
15 the frequencies of these events. But they are experts
16 on if you were given that event what would happen. So
17 it is well beyond the capabilities of the panel to
18 give the full LOCA probability distributions for these
19 rare things.
20 But it can be combined with other work
21 that has been done in the past to give you that. So
22 you have been trying to get the definition and I
23 finally made it there to the definition.
24 CHAIRMAN BONACA: No, I already had the
25 answer anyway.

1 MR. TREGONING: Can I move on?

2 CHAIRMAN BONACA: Go ahead.

3 MR. TREGONING: We have six categories of
4 LOCAs that we are looking at. Initially, we have
5 tired them to the leak rate threshold, and why do we
6 do that? Well, there is historical reasons for that.
7 That is how we have always done it.

8 MEMBER SHACK: I don't call a hundred-
9 thousand gallons a leak rate.

10 MR. TREGONING: A LOCA rate.

11 MEMBER KRESS: That is a fire hose and a
12 hearse anyway.

13 MR. TREGONING: We have six categories of
14 LOCA, the first three of which are consistent with the
15 historical definitions of a small break, medium break,
16 and large break LOCA.

17 And all we have done here is we have
18 further partitioned the large break LOCA size, and
19 this is the problem that we have had all along.

20 MEMBER WALLIS: Why do you use this absurd
21 unit of gpm when you have got steam coming out of this
22 hole?

23 MR. TREGONING: Well, you can measure
24 that. When I say a leak rate, this is really the rate
25 of the makeup system essentially.

1 CHAIRMAN BONACA: In the beginning.

2 MR. TREGONING: Right.

3 MEMBER WALLIS: There are very many

4 different gallons at that temperature than you do at

5 the leak.

6 MR. TREGONING: Right. But we tried to be

7 consistent and that is why this is the makeup rate.

8 So we partitioned the large break size and again, to

9 examine trends that happen when we get up to larger

10 break size.

11 Of course, when you get to this big guy,

12 that is essentially that you are only talking about

13 failures of the largest pipes in the largest pipes in

14 the plants. So this gets at our design basis right

15 here, and it gives us a narrow focus on just those

16 design basis type accidents.

17 The other thing that we have done, which

18 I have not shown, but we have gone back and looked at

19 some of the earlier correlations between leak rate and

20 break size, and we have reevaluated --

21 MEMBER WALLIS: I thought leak was a

22 dribble, and you try to figure out what is the

23 frequency of a LOCA as it is related to leaks. You

24 are not saying that at all. You are saying that LOCA

25 frequency is a function of slow rate out the break.

1 MEMBER SIEBER: Right.

2 MR. TREGONING: Right.

3 MEMBER WALLIS: I thought what you meant
4 was that you detect a leak and it is dripping. What
5 is the chance now that the pipe is going to break.

6 MEMBER SHACK: That's not what he meant.

7 MR. TREGONING: That is not what I meant
8 at all.

9 CHAIRMAN BONACA: They extended the
10 definition.

11 MR. TREGONING: This has been typically
12 what has been called a LOCA. The leak has not been
13 called a LOCA because it is within the makeup capacity
14 of the plant. Some people have called them very small
15 LOCAs over time, but we have never really analyzed it.

16 MEMBER WALLIS: This is absurd. LOCA size
17 based on, and what do you mean by that? The size of
18 the hole based on the flow rate?

19 MR. TREGONING: Yes, the size of the hole
20 based on the flow rate, yes.

21 MEMBER WALLIS: Then it has nothing at
22 this point to do with frequency?

23 MR. TREGONING: It has nothing at this
24 point to do with frequency.

25 MEMBER APOSTOLAKIS: The PRA definition of

1 the large LOCA is which one?

2 MR. TREGONING: This one.

3 MEMBER APOSTOLAKIS: Greater than 5000?

4 MR. TREGONING: Yes.

5 MEMBER APOSTOLAKIS: So that is what, 8

6 inches?

7 MR. TREGONING: It depends on the system,

8 but you are looking at 6 to 8 inches. It depends on

9 the plant, and it depends on where the break is

10 located, but it has always historically been about 6

11 inches.

12 MEMBER SHACK: Close enough for a PRA.

13 MEMBER APOSTOLAKIS: And we have

14 confidence that the experts can make a distinction

15 between something that is 4, 5, 6, categories 4, 5,

16 and 6? I mean, something that they can distinguish?

17 MR. TREGONING: What happens here is that

18 when you go up in leak rate, you effectively eliminate

19 systems that you have to consider.

20 MEMBER APOSTOLAKIS: So they are not

21 really thinking in terms of 25,00 gpm or 100,000.

22 They are thinking in terms of what does it really have

23 to break to get there.

24 MR. TREGONING: Yes. We have developed a

25 correlation between leak rate and break size that the

1 experts are using. So I didn't show this, because
2 this is how the panel developed it.
3 MEMBER APOSTOLAKIS: Call it LOCA rate.
4 Leak is really --
5 MEMBER WALLIS: You only need to call it
6 frequency prediction. Nobody cares about this --
7 MEMBER SHACK: No, frequency is a function
8 of size.
9 MR. TREGONING: You have to care about
10 that.
11 MEMBER SHACK: It makes a big difference.
12 MEMBER APOSTOLAKIS: Size does matter
13 here.
14 CHAIRMAN BONACA: That is the end point,
15 right?
16 MEMBER WALLIS: Well, let's move on.
17 MR. TREGONING: And we are looking at
18 three time periods. The current time period, which we
19 are at about an average of 25 years of operating
20 experience, and the design life, and then the design
21 life and extension.
22 So this is how the experts -- this is how
23 we generally classified the issues which affect LOCAs,
24 and this is inaccurate in a sense, because I don't
25 show safety culture in this, but you will see later

1 how we roll in safety culture.

2 MEMBER APOSTOLAKIS: Safety culture.

3 MR. TREGONING: How we try to roll it in.

4 MEMBER APOSTOLAKIS: What is your name

5 again? Actually, Abramson.

6 (Laughter.)

7 MR. TREGONING: You know Lee, and I can't

8 get away with that. I didn't say safety culture.

9 This is how we are dealing with the total LOCA

10 contribution. We split them as a group into passive

11 and active system LOCAs.

12 This is of course where we really have

13 service history data. Now, the elicitation is only

14 focusing on the passive system LOCA, but obviously in

15 the final numbers that we develop, we have to go back

16 and add up the relevant active system LOCA

17 contributions in.

18 And for some sizes these are probably

19 going to be probably dominant.

20 MEMBER APOSTOLAKIS: So where there at the

21 bottom do you have the time element in the sense that

22 something can be arrested before it becomes very bad?

23 MR. TREGONING: The time element is really

24 in all of this. It is in all of this.

25 MEMBER APOSTOLAKIS: But let's say that I

1 am looking at aging mechanisms there at the bottom,
2 and so I may have lots of accelerated corrosion, and
3 it is a mechanism on a certain time scale, but they
4 may catch it.
5 So all that stuff is there or are the
6 experts thinking exclusively in terms of the aging
7 mechanism.
8 MR. TREGONING: Time is in here and time
9 is also in materials, and that if you --
10 MEMBER APOSTOLAKIS: But what do the
11 experts know about all of this?
12 MEMBER SHACK: The experts think about how
13 long it takes to fail a thing by a given mechanism,
14 and how many changes you have to find it. What are
15 your chances of finding it, and all of that is sort of
16 rolled into the process.
17 MEMBER APOSTOLAKIS: And they are experts
18 at all that stuff?
19 MEMBER SHACK: That's why you have a range
20 of experts, but yes, they are all sort of framed to
21 think that way. That is how piping stress analysts
22 and fracture mechanics guys think.
23 MEMBER APOSTOLAKIS: Are these people
24 happy?
25 MR. TREGONING: Happy in the PRA world, I

1 think.

2 MEMBER APOSTOLAKIS: No, they can't be.

3 MEMBER FORD: Now just to come back to my

4 original outburst. I think I can understand now how

5 you are dealing with it, because you said -- I was

6 thinking of trying to do this continuously, and you

7 are saying no. I am asking Karen Gott, for instance,

8 do you think that that piping system, a 28 inch

9 scheduled piping in a BWR will last under the current

10 operating conditions of normal water chemistries, and

11 being quite specific, will it last 25 years.

12 And you are just asking her that question,

13 and she says yes, no, and you say, well, why. And so

14 is that the way it is working?

15 MR. TREGONING: Similar to that. Lee, do

16 you want to jump in here or do you want me to do it?

17 He was getting ready to come out of the chair. So I

18 figured I would call on him anyway.

19 MR. ABRAMSON: Lee Abramson, Research.

20 Essentially what we are going to be asking the experts

21 in their quantitative judgment is to make relative,

22 relative comparisons.

23 No one is going to be asked to make any

24 absolute number, and everything is going to be based

25 relative to base cases, and particular things which

1 they have some experience with, small break LOCAs, and
2 things int he base case.
3 That is why we spent a great deal of
4 effort in developing base cases which would be
5 presumably understood in the same way by all of the
6 experts. And then each of the experts are going to be
7 asked to make comparisons to the base case.
8 And in particular, we are going to go
9 through the range, and we are going to say, okay,
10 consider a medium break LOCA, however you define it,
11 and say how do you expert the frequency of this to
12 compare with, say, a small break LOCA, and same
13 material, same degradation mechanisms, and so on and
14 so forth.
15 So we are asking them to make relative
16 comparisons in the LOCA frequency under specific
17 conditions, and we are going to try to compare as much
18 as we possibly can, apples with apples.
19 So that experts in their own minds are
20 only going to have to say make a comparison juggling
21 maybe one thing at a time, rather than all things
22 together. That is the general philosophy of this
23 whole expert elicitation, is for the quantitative
24 estimates, and to make relative numbers compared to
25 things which they feel are pretty well established and

1 pretty well understood, namely the base cases.

2 MR. TREGONING: And in which we have

3 attempted to quantify. So that links back to the

4 quantifying.

5 MEMBER FORD: So of the 12 members that

6 you have, not all of them know a lot about stress

7 corrosion cracking?

8 MR. TREGONING: Correct.

9 MR. ABRAMSON: Correct.

10 MEMBER FORD: Or not a lot of them know

11 about the (inaudible).

12 MR. TREGONING: Correct.

13 MEMBER FORD: And so the experts who are

14 experts in those particular areas, will their answers

15 have a specific weighting compared with the others?

16 MR. ABRAMSON: Well, we are certainly

17 giving each expert the option of opting out of a

18 process that they feel that they don't really know

19 very much about it. That is another reason, of

20 course, for having a relatively large panel, because

21 then hopefully we will be able to get enough useful

22 answers from enough people on the panel so that we

23 will have some estimate of the uncertainly.

24 And we are explicitly asking each expert

25 for uncertainties on each of their answers. So if

1 somebody is particularly uncertain about it, it will
2 show up in his responses.
3 MEMBER APOSTOLAKIS: But, Lee, if the
4 evaluation of these bottom boxes there requires more
5 than one kind of expertise, why are you eliciting the
6 experts individually? Wouldn't it be better to do it
7 in subgroups?
8 You just mentioned that you will have a
9 guy who understands the degradation mechanisms, and
10 somebody else who understands the intervention, or
11 preventive measures and so on. So it would seem to me
12 that putting it in subgroups would make more sense.
13 So you have a group of people who -- a
14 subgroup who understands everything that is going on
15 with respect to this particular issue.
16 MR. ABRAMSON: Well, our basic idea is to
17 use the individual elicitation, because that is a way
18 to try to minimize the particular group dynamics that
19 you might get from a group.
20 And also I think it is very important here
21 to try to have the results reflect as much as possible
22 the real scientific uncertainty therein in these
23 answers.
24 MEMBER APOSTOLAKIS: Well, the biases,
25 Lee, that we are talking about that are in group

1 dynamics refer to groups of experts who are more or
2 less experts of the same things. In other words, if
3 I am looking only at flow accelerated corrosion, and
4 I have five experts for that subject, and then one of
5 them may dominate.
6 But the value of having a group, that
7 value comes to the surface if you are in a situation
8 where the expertise now, the experts compliment each
9 other. So nobody will dominate really in that case,
10 because I will respect your opinion, and you will
11 respect mine.
12 So this is something that is really
13 important I think to the elicitation process.
14 MR. ABRAMSON: I am not quite sure how to
15 answer that. Part of the answer may be, first of all,
16 as Rob suggested, we are trying to get people with a
17 broad range of experience, so that they are not just
18 narrowly expert in one particular aspect.
19 So that could be part of a response to
20 yours. How well this will work out, I can't say. And
21 another thing is that we are trying to break down --
22 I don't think that Rob is going to have the time to do
23 this, but if you look at the question, there are
24 literally probably hundreds of questions that we are
25 going to be asking, and the reason that there are so

1 many is because we try to ask them about extremely
2 specific situations.
3 And presumably in doing this, we will be
4 able to tap on their expertise as it applies to the
5 situations and to the degradation mechanisms, for
6 example, and something that they are familiar with.
7 I think how successful we are going to be
8 in this will probably -- I would expect that we would
9 probably have a pretty good sense of this after we get
10 through the elicitations.
11 MEMBER APOSTOLAKIS: Try it both ways.
12 Nobody is stopping you from doing that.
13 MR. ABRAMSON: Pardon me?
14 MR. TREGONING: Well, when we analyze it,
15 we will certainly analyze it both ways.
16 MEMBER APOSTOLAKIS: Anyway, I have a
17 point here, a different one. What is the purpose of
18 the presentation today? We are not writing a letter
19 are we?
20 MEMBER SHACK: We had not planned on
21 writing a letter. If the committee feels that there
22 is something that we need to address, then that is
23 something, but a letter was not planned.
24 MEMBER APOSTOLAKIS: Okay.
25 MEMBER SHACK: This was to inform the

1 committee how the process was going, and to get some
2 input from it. So when the answer comes back to us,
3 we --
4 MEMBER APOSTOLAKIS: Well, I propose the
5 following. It is obvious that there is great interest
6 in this by most of us, and this is of course one of
7 the most important issues that the agency is looking
8 at these days, right, 50-46 eventually.
9 I am not sure that we are going to get
10 very far today. We are going to have a hell of a lot
11 of questions. We have important letters to write. I
12 propose that we schedule a subcommittee meeting soon,
13 because you really have to see the details here to
14 appreciate what is going on to be convinced, and you
15 can't do that in a full committee meeting, and
16 terminate this as soon as we can.
17 MR. SNODDERLY: George, the purpose of
18 this meeting now was because it is such an aggressive
19 schedule, and the elicitation is scheduled to be done
20 by September, and when we looked at our schedule about
21 when we could schedule meetings.
22 So what we would like to try to do today
23 is to make you aware -- we have made you aware of who
24 is on the panel, and now to make you aware generally
25 of what elicitation questions are.

1 But I think it is going to be very
2 difficult for us to have much interaction before the
3 elicitation has been completed, and compiling the
4 results.
5 MEMBER APOSTOLAKIS: I think we are
6 achieving today something that is really unfair to the
7 NRC staff. You are creating negative attitudes on the
8 part of the members because they don't see the details
9 to appreciate what is going on.
10 MEMBER FORD: Well, I would not call them
11 negative, George, but they are inquiries, aggressive
12 inquiries.
13 MEMBER APOSTOLAKIS: Well, I mean are
14 concerned.
15 MEMBER SHACK: As a practical matter
16 though, George, if we have the subcommittee meeting,
17 we won't be able to have a committee response to the
18 subcommittee meeting.
19 We can have the subcommittee meeting for
20 information, but --
21 MEMBER APOSTOLAKIS: But this is an
22 extremely important topic. I mean, we can't say that
23 the committee cannot get involved in the excruciating
24 details because they have to do it by September 5th.
25 MEMBER SHACK: Well, can we continue with

1 this presentation and we will --

2 MEMBER APOSTOLAKIS: I would hate to go

3 beyond the allotted time.

4 MEMBER SHACK: Well, we're not.

5 MEMBER APOSTOLAKIS: Because there are

6 very important things to deal with.

7 MEMBER WALLIS: Are we going to be asked

8 to approve the results?

9 MEMBER APOSTOLAKIS: Eventually you will

10 be asked to do that, and to write a letter, yes. And

11 then at that time we will be told that we have already

12 done it. What do you want us to do, select new

13 experts? And I say that is unfair to the staff as

14 well.

15 MEMBER WALLIS: Well, we can say that our

16 role comes after the experts have done their work.

17 MEMBER FORD: But it is unfair to come in

18 at the end.

19 MEMBER SHACK: It is 4:09.

20 MEMBER APOSTOLAKIS: Yes, but this is an

21 important issue.

22 MR. TREGONING: And let me say that we are

23 planning to have the elicitations done by the end of

24 September and then we are looking to have a feedback

25 meeting from the experts where they get to see the

1 results, and they get to see how we analyzed it and at
2 least get the experts themselves to say if they agree
3 in the process and in the final results.
4 MEMBER WALLIS: So it is not finished?
5 MR. TREGONING: No, it is not finished,
6 and we are either telling people when they come in to
7 do their elicitation that if there is more information
8 that comes out later, and they want to change their
9 answers, they can certainly do that.
10 MEMBER WALLIS: I don't think we have to
11 be managing this process. We can look at the final
12 results.
13 MEMBER APOSTOLAKIS: No.
14 MR. TREGONING: And the way that we have
15 tried to structure the elicitation is we have tried to
16 decompose things; issues, topics, important
17 contributing factors. And at the end of the day, we
18 roll them all up.
19 If there is issues or contributing factors
20 that we have missed, and that you all point out, if
21 there is a flaw that we have missed, I would hope that
22 we could go back and it would be non-fatalistic at
23 that point, and we could essentially address it, and
24 see if it makes a difference or not, and then come
25 back and present the results.

1 Now the thing that would be harder to do
2 is if we wanted to reconstitute the panel in some way,
3 and if wanted to change who is on the panel.
4 MEMBER ROSEN: Which by the way is what I
5 suggest.
6 MEMBER APOSTOLAKIS: But the process may
7 be difficult to change, too. I mean, this idea of
8 providing individual elicitations, after a certain
9 point things are pretty costly. So I don't know what
10 to say, but it seems to me that this is one of the
11 biggest issues that the agency is working on.n
12 CHAIRMAN BONACA: I agree with that.
13 MEMBER APOSTOLAKIS: And I don't think
14 that schedule should be the determining factor here.
15 CHAIRMAN BONACA: Schedule what? The
16 whole program?
17 MEMBER APOSTOLAKIS: Yes.
18 MR. TREGONING: One of the things that I
19 will say to try to answer it and to follow up what Lee
20 said, we have combined the group and the individual.
21 The group is providing a lot of combined or background
22 information that the rest of the panel has access to.
23 So if there is a specific area that a
24 panel member does not have expertise in, we have been
25 trying to develop information so that they will have

1 that knowledge.

2 MEMBER APOSTOLAKIS: All I am saying is

3 that we really need to go deeply into this. Now when

4 we are going to do that, I don't know.

5 CHAIRMAN BONACA: Anyway, why don't we let

6 Robert go through.

7 MEMBER SHACK: I would really like you to

8 get to Slide 19.

9 MEMBER SIEBER: Before you leave that one,

10 what is the difference between passive and active

11 systems?

12 MEMBER ROSEN: Yes it would be nice to

13 know what is on this slide.

14 MR. TREGONING: Passive systems are pipes

15 and nozzles, and reactor pressure vessels, and things

16 like that. And active system LOCAs are things like

17 valves, and pump seals.

18 MEMBER SIEBER: You mean actual

19 components?

20 MR. TREGONING: Right. Active components.

21 MEMBER SIEBER: As opposed to passive

22 components?

23 MR. TREGONING: Right.

24 MEMBER SIEBER: Thank you.

25 MEMBER WALLIS: Somebody opens a valve and

1 leaves it open. That is an active --

2 MEMBER SIEBER: That is not a LOCA then.

3 MR. TREGONING: That is an active.

4 MEMBER ROSEN: It could be if it is a

5 relief valve.

6 MEMBER SHACK: That is one of the most

7 common LOCAs around.

8 CHAIRMAN BONACA: Exactly.

9 MR. TREGONING: That is an active

10 component. A passive would be a valve body failure,

11 let's say. That would be a passive component.

12 MEMBER WALLIS: I would think active

13 where somebody does something, like opening a letdown

14 system, and letting it run.

15 MR. TREGONING: No, that's active. Active

16 can contribute to a passive component failure.

17 MEMBER APOSTOLAKIS: Change of state.

18 MR. TREGONING: So we have talked about

19 the piping base cases, and so what are they exactly.

20 Well, these have been developed iteratively between or

21 among the facilitation team and the expert panel

22 members.

23 And what the people are doing is that they

24 are -- you sure you don't want to go to 18 for this?

25 MEMBER SHACK: Well, you already told us

1 18.

2 MR. TREGONING: Not really. I think we

3 need to go back to 18. The base cases we are using to

4 provide anchor. These base cases are very specific

5 variables for piping systems, size, material, loading

6 degradation, and mitigation. We have a very specific

7 set of conditions. We have defined five of them.

8 And for piping now. These are all for

9 piping at this point; 2 for BWR, and 3 for PWR. We

10 tried to hit some of the most important LOCA sensitive

11 systems and then also mechanisms and loading

12 histories.

13 So each of these are being -- we are

14 calculating the LOCA frequencies for each set of base

15 case conditions as a function of leak rate and

16 operating time. As I mentioned, we have four panel

17 members individually doing calculations; two using

18 operating experience, and two using PFM.

19 MEMBER RANSOM: How is historical data

20 factored into this?

21 MR. TREGONING: Yes, I am going to get to

22 that. In fact, you see it right here. But let me get

23 down there first. We developed these things

24 iteratively like I said. We are evaluating these at

25 three different time periods.

1 And to get down to how we are using the
2 operating experience, and where we have the most
3 operating experience is in terms of leaking cracks.
4 So we have told each of the four members that are
5 doing their analysis that they have to benchmark their
6 analysis so that you essentially get agreement to the
7 leaking crack frequency that you would get at an
8 average of 25 years, which is essentially where we are
9 now.
10 MEMBER RANSOM: I was thinking more of the
11 chemical industry, and even some of the nuclear
12 industry, where you have accelerated corrosion, and
13 you have pipe ruptures, and so there is a little bit
14 known about their frequency.
15 MR. TREGONING: There are, but again like
16 I mentioned earlier, we have really tried to limit to
17 nuclear experience only because of the uniqueness of
18 the materials degradation mechanisms, and then also
19 the quality of the materials, and the robustness of
20 the mitigation and maintenance procedures.
21 So that makes our industry unique enough
22 to I think only look at that specific subsection of
23 results. LOCAs were done in 1400, and in fact they
24 did go -- in fact, a lot of the early LOCA numbers
25 were based on oil and gas transmission piping, simply

1 because they did not have anything else, and not
2 because they thought it was relevant.
3 In fact, if you go back to WASH-1400,
4 there is a big disclaimer that says we don't think
5 that this is relevant. However, we have only got a
6 hundred or so years of operating experience, and we
7 don't feel that is enough basis to make a judgment at
8 this point.
9 So we think we have got enough operating
10 experience now, especially with precursors. We do
11 have pretty good precursor databases, and that is what
12 we have been looking at for the piping.
13 Another stipulation is we are trying to
14 make sure that all the base case calculations capture
15 the conditions that were established by the panel.
16 The panel determines what these conditions were, and
17 by conditions I mean again the degradation mechanism,
18 the geometry of the material, and the loading
19 conditions.
20 And along with these base case
21 calculations, we have also done sensitivity analyses
22 using PFM to look at the effect of seismic loading and
23 in-service inspections. So this gets at your question
24 what happens if you miss it, and what happens if you
25 don't. So how the probability of detection and the

1 resolution of the ISI affects it.

2 And look at variability and the loading

3 history. Of course, with PFM, this is a prime driver.

4 MEMBER SHACK: Well, let me just mention

5 for Vice, too, that Mr. Lydell is sort of the industry

6 custodian of the biggest and most complete, and most

7 detailed database on piping cracks. George knows it

8 because it is sort of a PRA.

9 When they need a frequency on something,

10 they go to that.

11 MEMBER APOSTOLAKIS: He also published in

12 my journals.

13 MR. TREGONING: He is okay.

14 MEMBER SHACK: In a sense, you know,

15 service experience is strongly plugged in here.

16 MR. TREGONING: So that is how we do the

17 piping. How do we do the non-piping. Well, we could

18 have done the same thing. We could have chosen

19 several presentative systems and then examined and

20 extrapolated the operating experience through

21 modeling.

22 We did not decide to do that because with

23 non-piping there is a whole or a much bigger range of

24 failure mechanisms that are in play just because you

25 are dealing with things that are not just piping. You

1 are dealing with bolts, and thermal sleeves, and
2 things that are totally different components.
3 So it didn't make sense to pursue this
4 approach any more. So what we are doing here, and
5 what we don't have for non-piping is we don't have the
6 same robust precursor database.
7 We are essentially trying to develop that
8 for leaking and cracking frequencies, and that is
9 something that we are working on quite feverishly as
10 we speak.
11 MEMBER FORD: Would that include cracks L-
12 grade or core shrouds?
13 MR. TREGONING: Core shrouds would not
14 lead to a LOCA.
15 MEMBER FORD: You are absolutely correct.
16 MR. TREGONING: CRDM nozzles.
17 MEMBER ROSEN: Reactor coolant pump casing
18 bolts.
19 MR. TREGONING: Yes. Yes. We talked
20 about a number of bolt failures.
21 MEMBER WALLIS: And the seals on the
22 pumps?
23 MR. TREGONING: Seals we are considering
24 as part of it, and because there is a maintenance plan
25 for seals, we are incorporating those into the active

1 component regime. And there is a lot of data on
2 seals, seal failures, and we are not looking at seal
3 failures.
4 MEMBER WALLIS: Well, thinking about
5 seals, it is not just the seal. It is the cooling
6 system for the seal, and there is a whole chain of
7 events which can fail a seal, and not just the seal
8 itself. Do you have to write a PRA for the seal?
9 MR. TREGONING: Again, we are not
10 explicitly considering the seal, because -- we will
11 roll it in after the fact.
12 MEMBER WALLIS: But you have to do it some
13 day.
14 MR. TREGONING: Yes, and we will deal with
15 the seal, I think, --
16 MEMBER WALLIS: But the thing itself, it
17 is a series of events which leads to the failure, and
18 that is what you have to somehow capture for some of
19 these things.
20 MR. TREGONING: Well, that is all of these
21 things.
22 MEMBER WALLIS: But some of them are
23 simpler than others.
24 MR. TREGONING: I have not found that one
25 yet unfortunately. Okay. So we are going to use

1 these leaking and crack component frequencies as our
2 anchor for our non-piping responses. And then each
3 expert is going to have to determine how to translate
4 that information into meaningful LOCA estimates.
5 So certainly not a trivial exercise, but
6 this is what the experts for the most part, this is
7 what they do for a living.
8 MEMBER APOSTOLAKIS: So in your training
9 session, you train them to think in terms of
10 frequency, or these are experts who have actually used
11 frequency?
12 MR. TREGONING: Like Lee said, we are
13 going to be asking only relative questions.
14 MEMBER APOSTOLAKIS: The training.
15 MR. ABRAMSON: Using relative quantitative
16 judgment.
17 MR. TREGONING: Right.
18 MEMBER APOSTOLAKIS: So all of these guys
19 have worked with probabilities in the past and they
20 understand what it means?
21 MR. ABRAMSON: They understand
22 frequencies, and we are not talking about
23 probabilities. We are talking about frequencies.
24 MEMBER WALLIS: You are not talking about
25 frequencies at all.

1 MR. ABRAMSON: The whole idea here was to
2 try to ask them questions --
3 MEMBER WALLIS: It is all probability
4 isn't it?
5 MR. ABRAMSON: The idea was to try to
6 phrase the questions in terms of the experts'
7 expertise, in terms of the systems that they have been
8 working with their whole career.
9 So we tried to frame the questions in
10 terms of extremely specific physical situations,
11 degradation mechanisms, and materials, and so on and
12 so forth, and so that sets the stage.
13 And then we say, all right, you have this
14 situation and compare it to what happened with a small
15 break LOCA or whatever. And the base case is what do
16 you think about the relative frequency, just relative
17 frequency difference. We don't ask them explicitly
18 about probabilities.
19 MEMBER APOSTOLAKIS: You are talking about
20 the base case development here now. So for the base
21 case the experts are asked to come up with
22 frequencies.
23 MR. ABRAMSON: No, the base case --
24 MEMBER APOSTOLAKIS: Then they do what you
25 say here.

1 MR. ABRAMSON: -- was done by specific
2 people, these four people on the panel, who are base
3 case -- they have experience in developing base cases,
4 and they develop the specific absolute numbers based
5 on their service experience and based on data for the
6 most part isn't it?
7 MR. TREGONING: Well, again, that's what
8 we had the four of them do. They each ran models and
9 predictions, extrapolating the service history
10 experience to give them LOCA estimates.
11 So not surprisingly, you have a range of
12 estimates among the four of them, which in some sense
13 gives us a measure of uncertainty, too.
14 MR. ABRAMSON: Right. And each expert on
15 the panel in the elicitation will be asked to choose
16 which base case they prefer to anchor towards, to
17 compare with.
18 MR. TREGONING: Or they can anchor just
19 with the conditions.
20 MR. ABRAMSON: Right.
21 MR. TREGONING: And then we will propagate
22 the uncertainty throughout their answers.
23 MEMBER APOSTOLAKIS: Now when you say
24 frequency information into meaningful LOCA estimates,
25 does that include uncertainty, the base case?

1 MR. ABRAMSON: The base case I don't think
2 explicitly includes uncertainties.
3 MR. TREGONING: Again, the base case for
4 non-piping is just going to be leaking and crack
5 component frequency data. So these are accounting for
6 things that have happened.
7 MEMBER APOSTOLAKIS: But you need a base
8 case for a large LOCA don't you?
9 MR. TREGONING: You need to go from this
10 leak and crack --
11 MEMBER APOSTOLAKIS: I am telling you we
12 really need a subcommittee meeting.
13 MR. ABRAMSON: I think we are doing this.
14 We have a base case for small LOCAs, and then we are
15 saying, all right, consider the comparable materials,
16 and degradation mechanisms, and what do you think are
17 the chances of a large one.
18 MEMBER APOSTOLAKIS: So the base case is
19 based on data as much as you can.
20 MR. ABRAMSON: Right.
21 MEMBER APOSTOLAKIS: And then you are
22 going to larger --
23 MR. TREGONING: Right, using a relative
24 comparison.
25 MEMBER APOSTOLAKIS: That is actually very

1 good.

2 MR. ABRAMSON: What we are doing is we are

3 extrapolating as much as we possibly can from the

4 observed data.

5 MEMBER APOSTOLAKIS: I like that.

6 MEMBER SHACK: But, for example, on the

7 hot- leg, you will have somebody compute a frequency

8 for the break of the hot-leg?

9 MR. TREGONING: For the break of the hot-

10 leg under, and we looked at the hot-leg specifically

11 for PWSCC cracking, but not the hot-leg under every

12 set of conditions, but the hot-leg for PWSCC.

13 MEMBER SHACK: For the PWSCC.

14 MR. TREGONING: Exactly. We will have a

15 set of frequencies.

16 MEMBER ROSEN: A complete break, or a

17 small break?

18 MR. TREGONING: They are looking at the

19 range of breaks.

20 MEMBER ROSEN: You will have them compute

21 a set of these things?

22 MR. TREGONING: Yes, for each leak

23 pattern.

24 MEMBER ROSEN: How likely is it to have a

25 double-ended rupture and presumably you could plot

1 that?

2 MR. TREGONING: They have done all the six

3 LOCA categories that I listed, and for the hot-leg,

4 they could fill in also those numbers. We have had

5 them do it for smaller piping systems, too, where you

6 can only get up to a Category 1, 2, 3, or maybe 4,

7 LOCA.

8 You can't get the bigger ones, but you can

9 get a range of smaller ones. So, yes, that is exactly

10 right. They look at the frequency of small breaks and

11 then all the way up to the largest break possible.

12 MEMBER WALLIS: You have about a half-a-

13 ,minute per slide and a minute to wrap up.

14 MR. TREGONING: Bill, tell me where to

15 jump to.

16 MEMBER SIEBER: Tell me about the second

17 bullet.

18 MR. TREGONING: I will be happy to.

19 MEMBER APOSTOLAKIS: You are actually

20 serious.

21 MR. TREGONING: Let me go to this one,

22 because --

23 MEMBER SHACK: Hit 22 and 28, and we will

24 call it quits there. This one and then 28.

25 MR. TREGONING: I figured you would want

1 to see 28. These are the areas that we are asking
2 them questions about. We are asking the experts to
3 validate or evaluate the base case and how that
4 evaluation went. Do they agree with the numbers and
5 do they not agree with the numbers. Do they have
6 different numbers that they would like to use.
7 What anchoring set of conditions do they
8 want to use. Then we are asking generic questions
9 about regulatory and utility safety culture. And we
10 had a kick-off meeting and we identified a whole host
11 of issues within here that could affect LOCAs. We
12 decided --
13 MEMBER ROSEN: How would this team know
14 anything about utility safety culture? There is only
15 one guy on the team that can have any background.
16 MR. TREGONING: Again, we had --
17 MEMBER SIEBER: That is my question.
18 MR. TREGONING: Again, between
19 Westinghouse, and Exelon, and GE --
20 MEMBER ROSEN: I'm sorry to laugh, but
21 does Westinghouse know about utility safety culture?
22 MR. TREGONING: Industry safety culture.
23 MEMBER ROSEN: I'm an adult.
24 MEMBER APOSTOLAKIS: Okay. So you got the
25 comment. Let's move on.

1 MR. TREGONING: So we are asking them
2 generally about these issues, and then we are also
3 asking about again LOCA frequencies for piping and
4 non-piping, and then these conditional probabilities
5 under emergency faulted loads.
6 MEMBER APOSTOLAKIS: Okay.
7 MR. TREGONING: This is 28, and this talks
8 about the passive code development, and so we will be
9 using this to provide confirmatory analysis. The
10 objective of this is to determine again the same
11 relationship, but to do it computationally as much as
12 possible, and it is a pool that we will be using for
13 continual --
14 MEMBER APOSTOLAKIS: Excuse me, but why
15 does it have to be confirmatory? Why isn't this an
16 additional piece of information that some super being
17 will combine and blend with the results of the expert
18 opinion in your elicitation exercise?
19 MR. TREGONING: Theoretically, it would.
20 MEMBER APOSTOLAKIS: But that is what you
21 will do in fact. I don't think that you are trying --
22 your objective here is not to tell the world the
23 experts are good. Your objective is to -- you say,
24 look, I really don't know what the frequency of large
25 breaks is, but I have a body of knowledge here which

1 is represented by experts.

2 I have a body of knowledge here that is

3 represented by calculational models. I will do both,

4 and then I will sit back and see how I can put them

5 together. If they happen to agree, then great. But

6 if they don't agree, I will have to do something. But

7 when --

8 MR. TREGONING: When I used confirmatory,

9 I didn't mean validate, per se.

10 MEMBER APOSTOLAKIS: Don't do it again.

11 MR. TREGONING: I meant exactly what you

12 said.

13 MEMBER APOSTOLAKIS: I know you did.

14 MR. TREGONING: A somewhat independent

15 assessment, although we are using some of the results

16 with the elicitation to feed into our codes, and so

17 they won't be entirely independent.

18 MEMBER APOSTOLAKIS: Fine.

19 MR. TREGONING: But it will be another

20 tool or another approach to evaluate or to get to the

21 same question.

22 MEMBER APOSTOLAKIS: Right. And

23 ultimately perhaps you may want to have another group

24 of experts taking all this information and just saying

25 this is it, the technical facilitator integrator.

1 MR. TREGONING: Yes. Hopefully I won't be
2 involved in that aspect.
3 MEMBER WALLIS: So this is all written up
4 at the end so that someone can understand it?
5 CHAIRMAN BONACA: Of course.
6 MR. TREGONING: Yes, of course it is
7 written up at the end, and hopefully people will
8 understand that. That has been our goal. In fact, we
9 have been heavily documenting the process as we go.
10 MEMBER WALLIS: I think it is very
11 important for this particular issue that you have a
12 very understandable rationale at the end.
13 MEMBER APOSTOLAKIS: I would like to see
14 actually an example with numbers walking through the
15 whole exercise.
16 MR. TREGONING: Yes. I would have been
17 happy to present that, but given the time --
18 MEMBER APOSTOLAKIS: There is no way
19 today, but we should do that well before we have to
20 write a letter.
21 MEMBER SHACK: Let me talk to you about
22 this again, George. We will be discussing this matter
23 again in the future.
24 MEMBER APOSTOLAKIS: But not at the full
25 committee meeting.

1 MEMBER KRESS: No, the subcommittee.

2 MR. TREGONING: I am sure at the full

3 committee we will be discussing it, too.

4 MEMBER SHACK: At the full committee, we

5 will be discussing it, too.

6 MEMBER ROSEN: I think we need a letter.

7 MEMBER APOSTOLAKIS: Now?

8 MEMBER ROSEN: Yes.

9 MEMBER SHACK: Why don't you just finish

10 the slide and we will discuss that.

11 MR. TREGONING: Well, again the approach,

12 we are constructing separate modules for piping and

13 non-piping, and then again these surprise mechanisms

14 that we have talked about.

15 We are trying to couple again through the

16 code PFM modeling with an understanding of operating

17 experience. We want to make sure that the modeling

18 frequencies are scaled based on this operating

19 experience. Again, we will be using insights from the

20 elicitation to focus on the most important systems and

21 mechanisms.

22 And there is a European program called

23 NURBIM that has similar objectives that we will be

24 working with on this effort. And also in terms of our

25 LOCA precursor development, too, there is also

1 international efforts for the development of piping
2 databases that we are part of, and I think we will
3 also look at starting up one for non-piping LOCA
4 precursor events, too.
5 So we are looking at starting up an
6 international effort there, too. So that is it.
7 MEMBER KRESS: I would like to ask you a
8 provocative question. I think this is good stuff, and
9 stuff that needs to be done, and will help us in risk
10 analysis and other places. The question that I would
11 ask is how are you going to use this to help risk
12 informed 10 CFR 50.46?
13 How will it be put to use in risk-
14 informing 10 CFR 50.46, which is the title of this.
15 MR. TREGONING: Do you want me to tackle
16 it? Do you guys want to tackle it?
17 MS. MCKENNA: This is Eileen McKenna, NRR.
18 We have a working group that has been tasked to work
19 on the rule making that would take advantage of the
20 information --
21 MEMBER KRESS: This is a question for NRR,
22 you're right.
23 MS. MCKENNA: Yes, and our schedules are
24 running in parallel, and so we are kind of having to
25 figure out what we are going to do with it before we

1 know what we are going to get.

2 But we are trying to deal with the issues

3 that you are also seeing in the SRM about what kind of

4 risk cut-off metrics we should be considering, and

5 some of the other considerations that we need to bring

6 to bear in making decisions with respect to what kinds

7 of changes might occur as a result of redefining the

8 maximum break size and what kinds wouldn't occur.

9 And those kinds of issues that we are

10 actively working on, and we will be discussing it at

11 a future meeting with the committee, but we just are

12 not ready to have that kind of dialogue.

13 MEMBER KRESS: Well, expressly, I was

14 hoping you would say that you will not say that given

15 your frequency as a function of leak size that you

16 will determine the contribution of these different

17 sizes to risk, and cut off at a given risk.

18 I am hoping that is not what you want to

19 do with it.

20 MS. MCKENNA: We hear you, and that is not

21 our current plan.

22 MR. TREGONING: But realizing that this is

23 just one technical piece,a nd that research is ongoing

24 and will be ongoing in looking at integrating this,

25 with probablistic risk assessment and thermal

1 hydraulic analysis to come up with hopefully a
2 technical basis behind whatever change is envisioned
3 for the ECCS rule.
4 MEMBER FORD: I have got a question along
5 somewhat other similar lines. It is my understanding
6 that the rule making, once it is made, is somewhat
7 cast in concrete. And yet this particular technology
8 is forever being developed further.
9 So in 2 years time when we may have a
10 different perspective of how you predict the future
11 behavior of leak rates and the effect on risk, it
12 might be different in 2 years time. Do we have the
13 wherewithal to change the rule?
14 MEMBER KRESS: Hopefully you will write
15 the rule so that is accounted for.
16 MS. MCKENNA: This is Eileen McKenna
17 again. I think if you read the SRM, you will see that
18 some of that concept was already built into that. It
19 talks about doing kind of doing a relook of the
20 frequencies and potentials for changes, and things
21 having to be undone, and obviously this poses a great
22 challenge for us in regulatory space of how to deal
23 with that kind of a process, which is very different
24 than what we have done in the past. But that is part
25 of the SRM also.

1 MEMBER FORD: The reg guides can be
2 changed.
3 MS. MCKENNA: yes.
4 MEMBER ROSEN: I would like to say why I
5 think we need a letter.
6 MEMBER SHACK: Is there anything else
7 before I turn it back over to the chairman?
8 CHAIRMAN BONACA: Okay. Thank you for the
9 presentation, and I think at this stage we can go off
10 the record now.
11 (Whereupon, at 4:34 p.m., the meeting was
12 recessed.)
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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 504th 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.

Debra Wilensky

Debra Wilensky
Official Reporter
Neal R. Gross & Co., Inc.

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
504th MEETING
MIXED OXIDE (MOX) FUEL FABRICATION FACILITY
ROOM T-2B3, 11545 ROCKVILLE PIKE
ROCKVILLE, MARYLAND

JULY 10, 2003

-PROPOSED SCHEDULE-

SUBJECT	PRESENTER	TIME
I. Introductory Remarks Subcommittee Chair	D. A. Powers, ACRS	8:35 - 8:40 a.m.
II. Industry and NRC Presentations		8:40 - 10:15 a.m.
Introduction	A. Persinko, NMSS	
General facility mission and layout	P. Hastings, DCS	
Safety Philosophy - Prevention features (redundancy, reliability limits) - Mitigation features (confinement zones, HEPAs) - Safe facility configuration	P. Hastings, DCS	
Estimated Risk to the Public	P. Hastings, DCS	
Criticality Safety	M. Chatterton/C. Tripp, NMSS	
Fire Safety	R. Wescott, NMSS	
Red Oil	A. Murray/W. Troskoski, NMSS	
Seismic	TBA, NMSS	
Estimated Risk to the Public /Five Factor Formula	R. Wescott, NMSS	
Remaining Open Items	A. Persinko, NMSS	
III. Committee Discussion		10:15 - 10:30 a.m.

MIXED OXIDE FUEL FABRICATION FACILITY

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS PRESENTATION

July 10, 2003

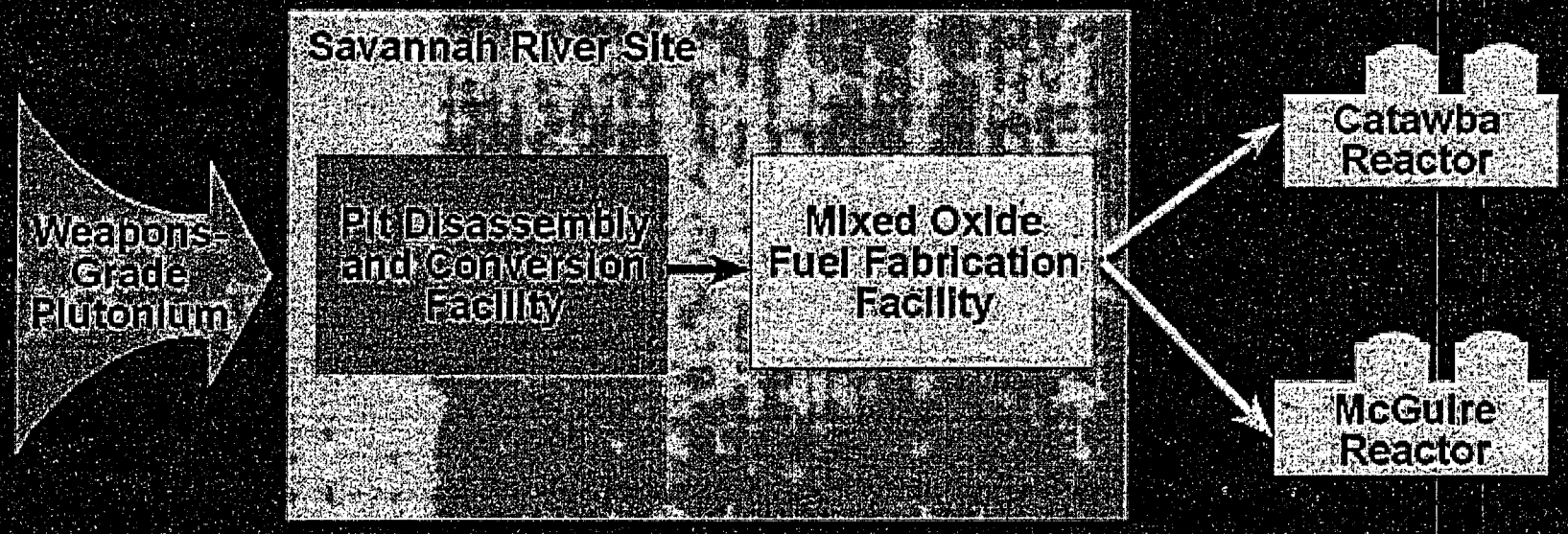
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS PRESENTATION

Review of the Mixed Oxide Fuel Fabrication Facility
Construction Authorization Request

Introduction

Andrew Persinko, Sr. Project Manager
NMSS/FCSS/SPIB

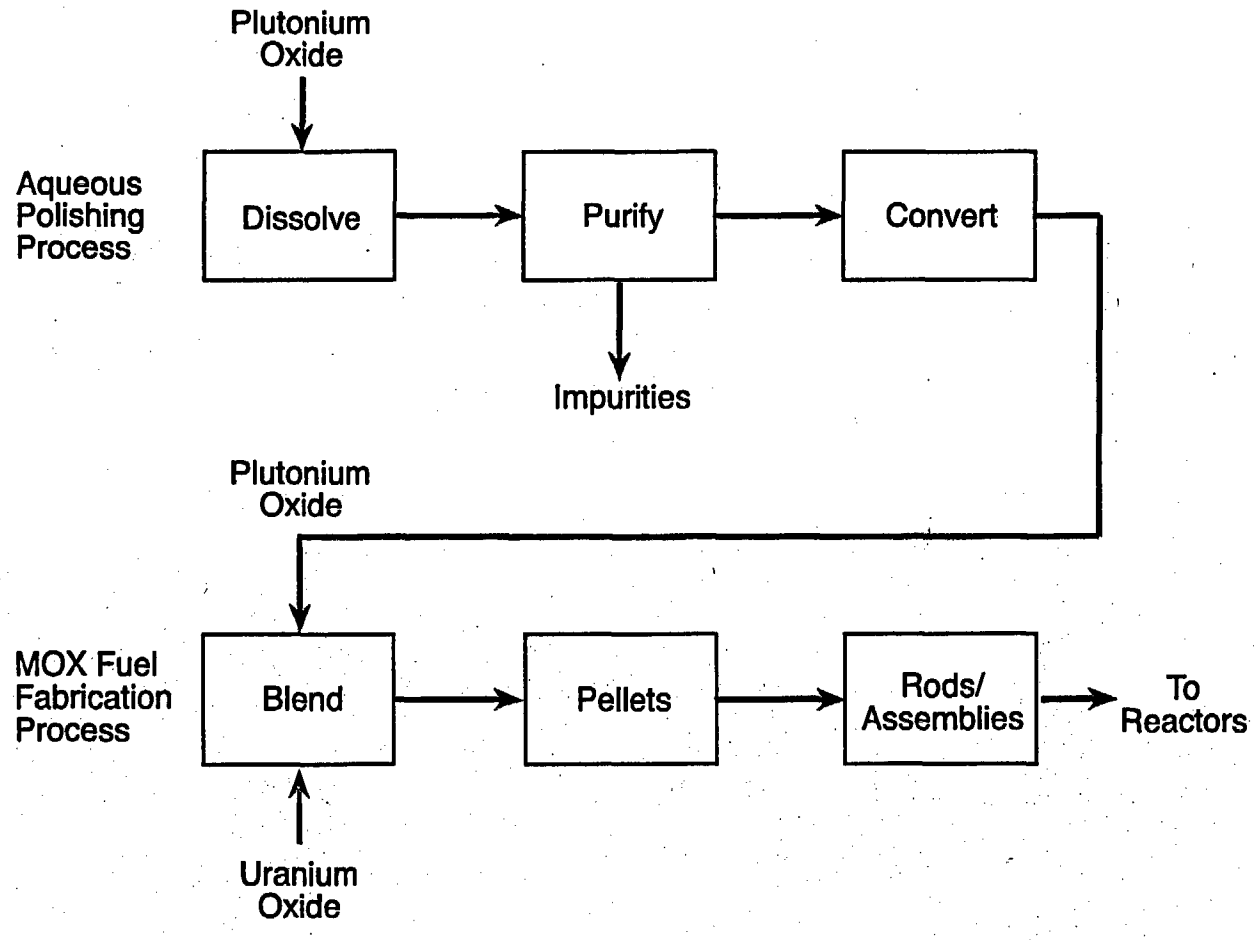
NRC Role in Regulating Mixed Oxide Fuel



Yellow = NRC regulated

Blue = DOE regulated

Mixed Oxide Fuel Fabrication Facility Process



Mixed Oxide Fuel Fabrication Facility

Licensing (10 CFR Part 70)

- 2-step approval:
  - Construction
  - Operation/possession of special nuclear material
- Approvals to start construction plutonium facility
  - Design bases of principal structures, systems, and components (PSSCs)
  - Quality assurance program
  - Environmental impact statement
- Principal structures, systems, and components / Items relied on for safety

Construction

Design Bases

- 10 CFR 50.2 Definition:

"Design Bases means that information which identifies the specific functions to be performed by a structure, system, or component of a facility and the specific values or ranges of values chosen for controlling parameters as reference bounds for design..."

10 CFR 70.61 Performance Requirements

	Highly Unlikely	Unlikely	Not unlikely
High Consequence Publ Dose > 25 rem Worker Dose > 100 rem	Acceptable	Not Acceptable	Not Acceptable
Medium Consequence Publ Dose 5 - 25 rem Worker Dose 25 -100 rem Env releases > 5000 Tbl 2	Acceptable	Acceptable	Not Acceptable
Low Consequence Publ Dose < 5 rem Worker Dose < 25 rem	Acceptable	Acceptable	Acceptable

Schedule

Major Milestones

- Received Environmental Report 12/19/00
- Received Construction Authorization Request (CAR) 2/28/01
- Issued draft Safety Evaluation Report (SER) for construction 4/30/02
- Received revised Environmental Report 7/11/02
- Received revised CAR 10/31/02

Schedule

Major Milestones

- Issued draft Environmental Impact Statement (EIS) for public comment 2/28/03
- Issued revised draft SER for construction 4/30/03
- Issue final EIS and final SER 9/03
- Issue EIS Record of Decision (ROD) and construction licensing decision 10/03

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS PRESENTATION

Nuclear Criticality Safety Review for the Mixed Oxide Fuel Fabrication Facility Construction Authorization Request

Christopher S. Tripp, Sr. Nuclear Process Engineer (Criticality)
NMSS/FCSS/SPIB

NCS Design Bases

- Double Contingency Principle (DCP)
- Maximum k-effective for criticality calculations
- Subcritical under normal and abnormal conditions
- Dominant parameters for major processes
- Preference for engineered over administrative control
- Criticality accident alarm system
- Management measures
- Organization and administration
- Technical practices (including ANSI standards)
- Balance of fire protection and criticality risk

Controlled Parameters (Waste Storage)

- Waste to be stored at MFFF
- Waste to be processed under DOE jurisdiction
- Control strategy:
  - Dual controls on concentration/mass
  - Adherence to DCP
  - May consist of active and passive engineered means, dual sampling
- Consistent with usual industry practice for auxiliary systems (e.g., ventilation, acid/solvent recovery)

NCS Open Issue (NCS-4)

- K-effective limits for 5 different AOAs:
  - Pu nitrate solutions
  - MOX pellets, rods, assemblies
  - PuO_2 powder
  - MOX powder
  - Pu compounds

- Methodology for normal condition minimum subcritical margin (abnormal = 0.05)

NCS Open Issue (NCS-4)

Criticality Code Validation

- Few critical benchmarks with required absorbers, range of parameters
- Use of sensitivity/uncertainty methods (SCALE 5) for powder systems
- Lumping all benchmarks into same AOA
- Rigor of methods used to demonstrate benchmark applicability

NCS Open Issue (NCS-4)

Criticality Code Validation

- Received Validation Report January 2003
- Meeting on major issues March 2003
- Received SCALE 5 (sensitivity/uncertainty code) May 2003
- Issued RAI June 2003
- Performing independent sensitivity/uncertainty analysis for solution, powder, and compounds

Conclusions

- Design bases acceptable except k-effective limits
  - Validation of AOAs
  - Normal case subcritical margin
- Identified early as main technical challenge for NCS
- Staff reviewing validation report
- SCALE-5 code being used

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS PRESENTATION

Fire Protection Review of the Mixed Oxide Fuel Fabrication Facility Construction Authorization Request

Rex Wescott, Integrated Safety Analysis Specialist
NMSS/FCSS/SPIB

Fire Protection

OVERALL DESIGN BASES: Assure that the 10 CFR 70.61 Performance Requirements are complied with under all credible fire scenarios

- Prevention
  - AP process cells
  - Inerted gloveboxes
- Suppression and/or combustible loading controls
  - Truck bays
  - Secured warehouse
  - Glovebox areas (clean agent suppression)
  - Fuel rod and canister storage areas
- Fire barriers
  - Confinement of internal fires to one fire area
  - Protection against external fires

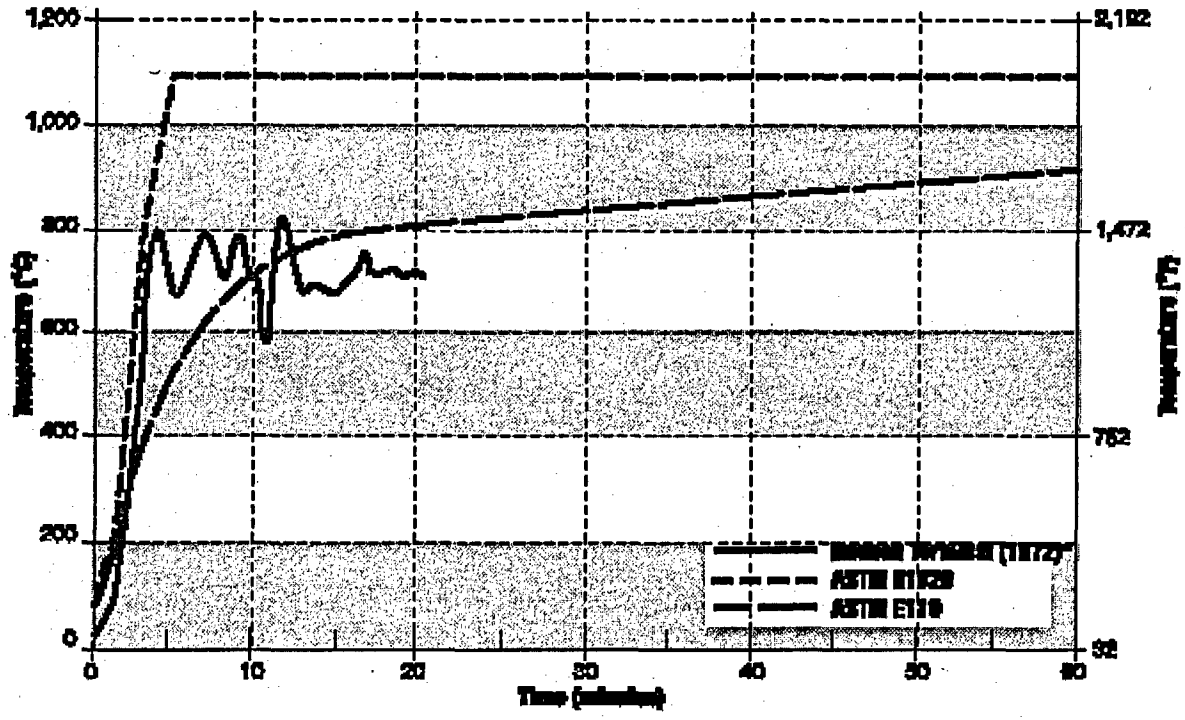
Fire Design Basis Values

- Compartment or fire area boundaries -- 2 hour fire as per ASTM E-119
- Compartment air temperature into ventilation system -- 2000°F to protect final HEPA filters
- Material confinement barriers --
  - 3013 transport cask -- 1472°F for 30 minutes
  - MOX fuel transport cask -- 1472°F for 30 minutes

Open Issue: Fire barriers

- Applicant has evaluated fire scenarios where temperatures could exceed the ASTM E-119 curve (reagent storage area)
- It must be demonstrated that fire barriers can withstand the rapid fire development without loss of integrity

Comparison of standard fire test curves with office fire experiment



*Hudson Terminal experiment conducted with normal office fuel load (6 psf) (DeCicco, et al. 1972)

Figure A-3 Comparison of exposure temperatures in standard tests.

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS PRESENTATION

Tributyl-Phosphate (TBP) -Nitrate
(Red-Oil) Review for the Mixed Oxide Fuel Fabrication
Facility Construction Authorization Request

Alexander Murray, Sr. Chemical Process Engineer
NMSS/FCSS/SPIB

Description of Tributyl-Phosphate (TBP) -Nitrate (Red Oil)

- Chemical reaction of TBP/organics and nitric acid/nitrates
- Reaction can runaway - generate thermal energy and non-condensable gases
- Reaction rate is a function of chemical species, concentrations, temperature, and pressure; radiolysis can contribute to the phenomena
- Impurities and intermediates exacerbate the phenomena
- Red oil reactions are explosive under certain conditions

Background

- There are 4 reported accidents with equipment damage and facility release
- There is 1 accident with offsite release (Tomsk)
- Literature implies several "incidents" have occurred
- DCS has recognized red oil as an explosion event and has proposed a prevention strategy

Applicant's Approach

- 3 PSSCs, 5 safety functions, and distinction of open versus closed systems
  - Offgas: vent path (open) or evaporative cooling (closed)
  - Process Safety Control Subsystem: Steam temperature and residence time
  - Chemical Safety Control (Administrative): diluent selection and degraded organic compound quantity limit

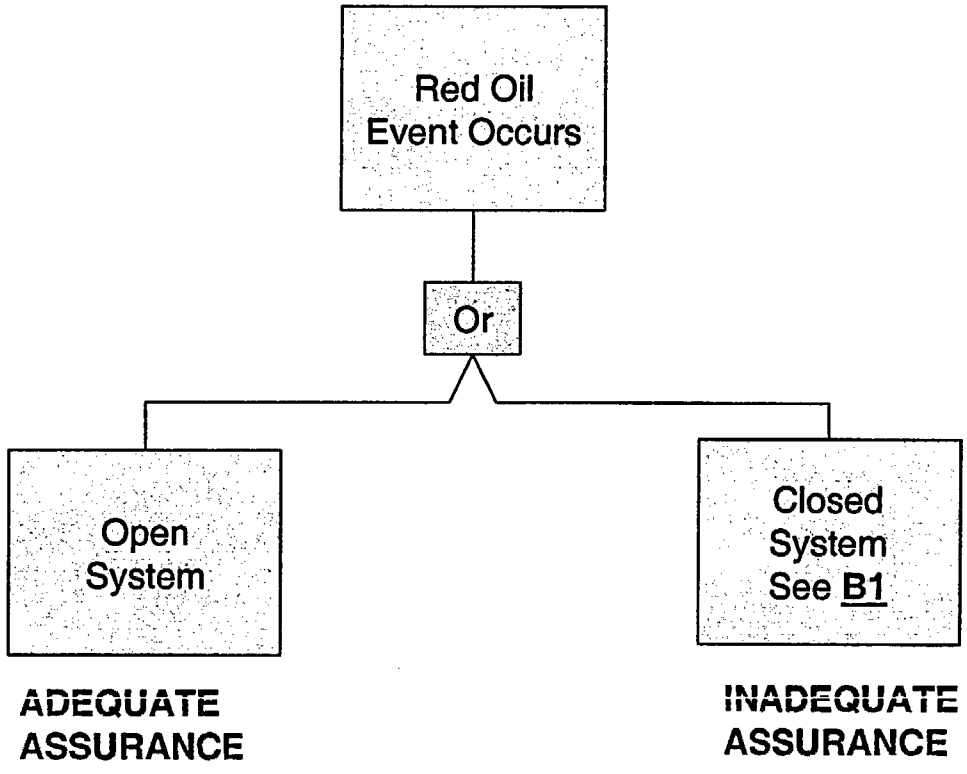
Open and Closed Systems

- Open system: capable of venting the full runaway reaction based upon experimental results (SRS), safety factor of 2.5, and assumption of 100% organics in system

- Closed system: Mass transfer to assure evaporative cooling at nitric acid/water azeotrope
  - vessel can have significant organics but not 100%
  - Safety factor 1.2 x [energy input + energy generation] with steam limited to 133°C
  - incapable of venting full runaway reaction (system would pressurize)

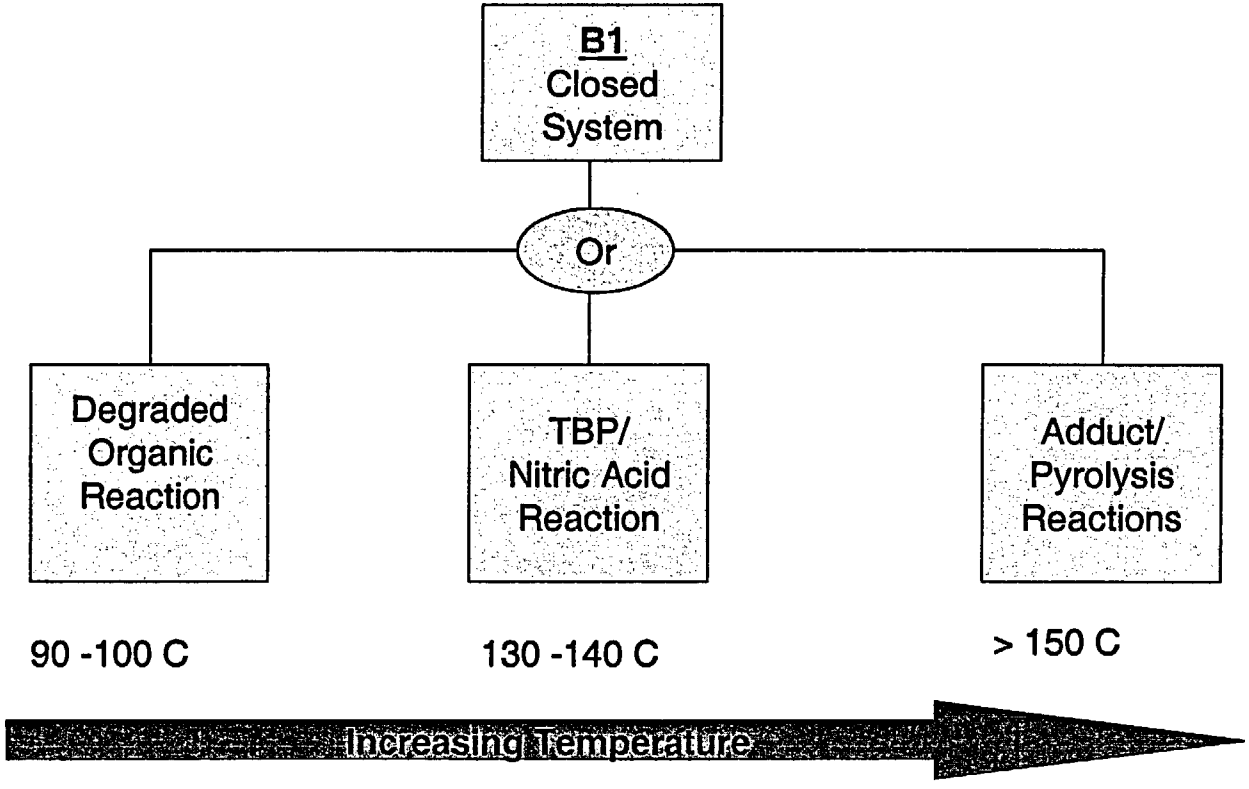
Top Level Fault Tree: Open Systems vs. Closed Systems

Initial Tree



Closed System Fault Tree - Top

FTA – Second Level



Conclusions

- Open system: approach capable of meeting "highly unlikely" and is acceptable
  - applies to most vessels (unheated)

- Closed system: approach not currently accepted by staff
  - likelihood of potential event not "highly unlikely"
  - some differences with approaches at existing facilities
  - limit solution temperature susceptibility to increases (steam pressure/temperature fluctuations, degraded/loss of venting capability)
- DCS to provide additional information to the NRC

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS PRESENTATION

Seismic Review of the Mixed Oxide Fuel Fabrication Facility Construction Authorization Request

John Stamatakos
Rex Wescott
Herman Graves, III

DCS Approach to Seismic Design

- Seismic Design Based on Four-Part Seismic Hazard Assessment
  - Generic probabilistic seismic hazard assessment (PSHA) for the Savannah River Site.
    - Based on Lawrence Livermore National Laboratory (LLNL) and Electric Power Research Institute (EPRI) sesimic hazard studies for Central and Eastern United States.
    - DCS established design basis earthquake by implemented DOE Standard 1023 (parallels methodology in NRC Regulatory Guide 1.165).
    - Design basis earthquake based on DOE performance categories defined in DOE Standard 1020 with PC-3 and PC-4 (mean hazards at 5×10^{-4} and 1×10^{-4} annual exceedence probabilities).

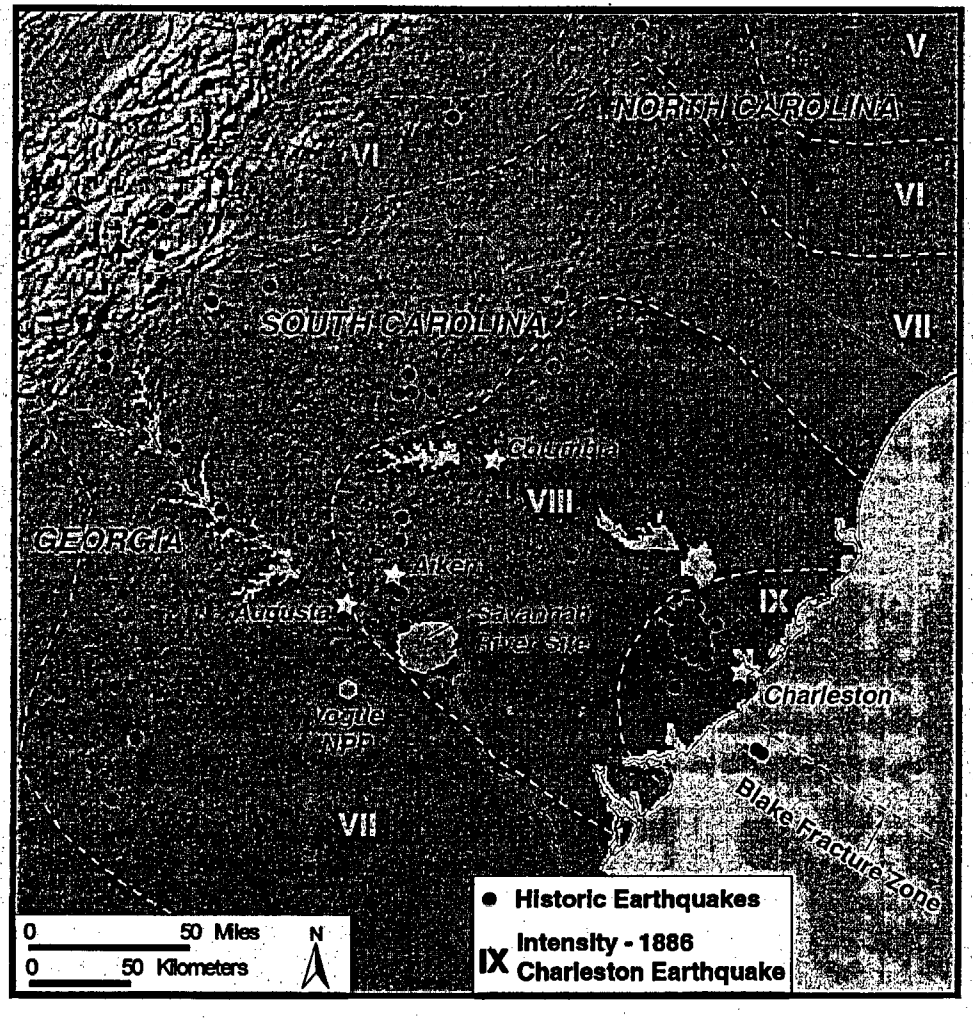
DCS Approach to Seismic Design (Continued)

- Facility design based on Regulatory Guide 1.60 spectra scaled to 0.20 g peak ground acceleration (Plant Vogtle NPP).
  - Target 1×10^{-4} mean annual exceedence probability for ground motions at frequencies of interest.
  - Design uses Regulatory Guide 1.60 horizontal soil surface spectrum scaled to 0.20 peak ground acceleration to meet this goal.
  - Vertical spectrum is also based on NRC Regulatory Guide 1.60 scaled to 0.20g peak ground acceleration.

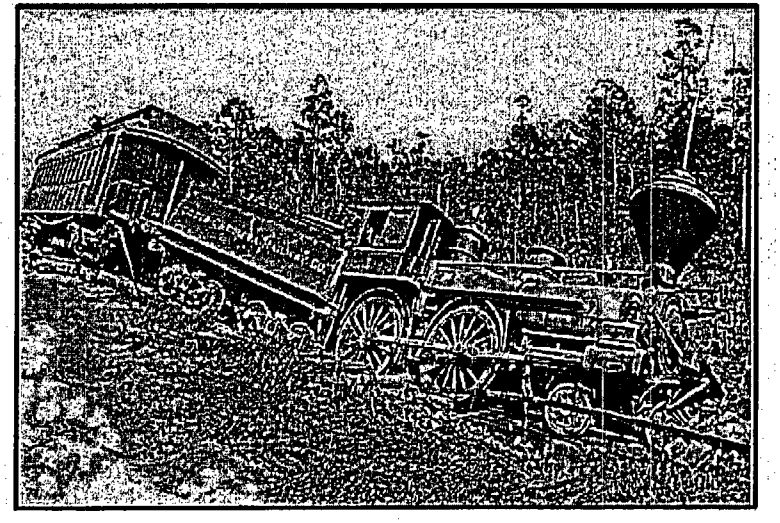
DCS Approach to Seismic Design (Continued)

- Soil stability analyses based on LLNL and EPRI seismic hazard results adjusted for site response.
  - Mean soil amplification factors were developed from site response model to scale the bedrock uniform hazard spectra to the soil surface.
  - DCS also developed alternative site-specific amplification functions (bedrock to soil surface) to validate response model.
  - For soil stability analyses, DCS used the bedrock PC-3 ground motions scaled so that when amplified throught the soil they produce surface ground motions with 0.20 peak ground acceleration.

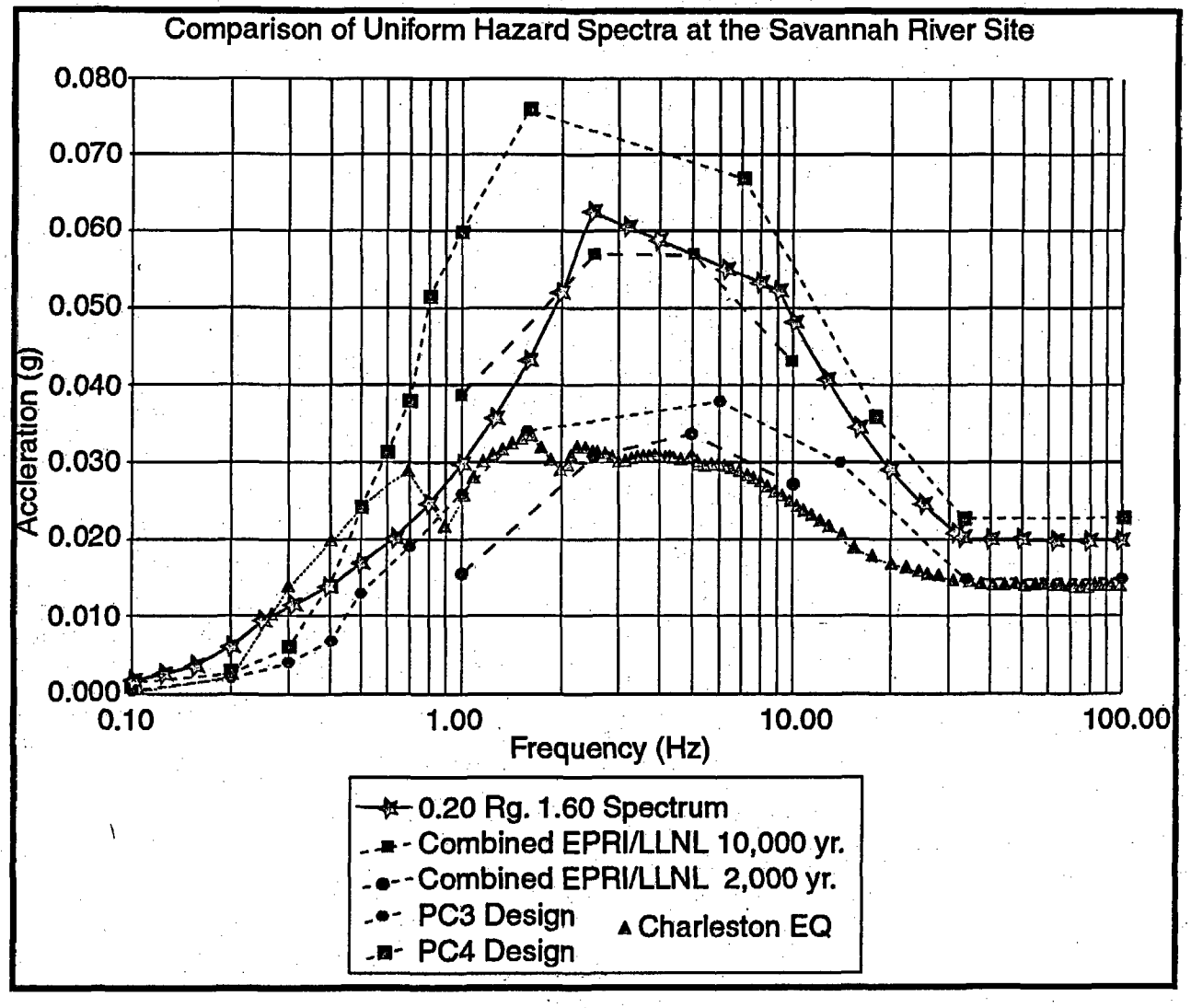
DCS Approach to Seismic Design (Continued)



- "Historic Check" using repeat of the 1886 Charleston Earthquake.
  - Magnitude =7.3 at Distance of 120 km from the site.



Summary of MOX Seismic Hazard and Design Spectra



Confirmatory Risk Assessment

- DCS performed limited probabilistic risk assessment on representative systems, structures, and components (e.g., offsite power, glove box, building structure).

- DCS showed seismic performance of these systems, structures, and components is 1×10^{-5}/yr or better, consistent with guidance in NUREG 1718.

Staff Evalaution

- Bedrock Seismic Hazard
  - Application of LLBL and EPRI hazard results is appropriate.
- Site reposnse
  - Site response models, based on site-specific soil data, are adequate.
- Sesimic Design
  - Regulatory Guide 1.60 spectra scaled to 0.20 g peak ground acceleration envlopes uniform hazard spectrum and Charleston Earthquake "historic check" at frequencies of interest.
  - Probabilistic risk assessment shows that critical systems, structures, and components consistent with performnce objectives in NUREG-1718.

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS PRESENTATION

Safety Assessment:
Radiological Consequences

Rex Wescott, Integrated Safety Analysis Specialist
NMSS/FCSS/SPIB

Overview

Safety Assessment: Radiological Consequences

- The staff's review of the applicant's radiological consequence calculations included review of:
  - Source term calculations
  - Facility worker dose estimates
  - Downwind consequence calculations
  - How the applicant's safety strategy reduces the risk to each receptor.

Safety Assessment: Radiological Consequences

Source Term using Five Factor Formula

- The staff reviewed:
  - material-at-risk (MAR)
  - damage ratio (DR)
  - atmospheric release fractions (ARFs)
  - respirable fractions (RFs)
  - leak path factors (LPFs) (i.e., HEPA filters)

Safety Assessment: Radiological Consequences

Source Terms: Applicant's proposed methodology

- ARFs and RFs were assigned for each type of material and each event.
- Material release forms
  - Solution
  - Powder
  - Pellet
  - Rod
  - Unencased filter
- Events
  - Explosive detonation
  - Explosive overpressurization
  - Fire/boil
  - Drop
  - Entrainment

Safety Assessment: Radiological Consequences

Source Terms: Applicant's proposed methodology (cont.)

- For example:
  - Powder, fire: ARF x RF = $6 \times 10^{-3} \times 0.1 = 6 \times 10^{-4}$
  - Solution, explosion = $1.0 \times 0.01 = 10^{-2}$
  - Rods, dropped = $3 \times 10^{-5} \times 1.0 = 3 \times 10^{-5}$
    - Source: Table 9.1-5 of the April 30, 2003 DSER

Safety Assessment: Radiological Consequences

Source Terms: Staff's Evaluation

- DSER, Section 9.1.1.4.2:
  - Staff finds the values chosen by the applicant to be consistent with recommendations in NUREG/CR-6410, and find them acceptable for construction authorization.
- Staff will review all 5 factors again during review of the Integrated Safety Analysis

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS PRESENTATION

Review of the Mixed Oxide Fuel Fabrication Facility
Construction Authorization Request

Remaining Open Items

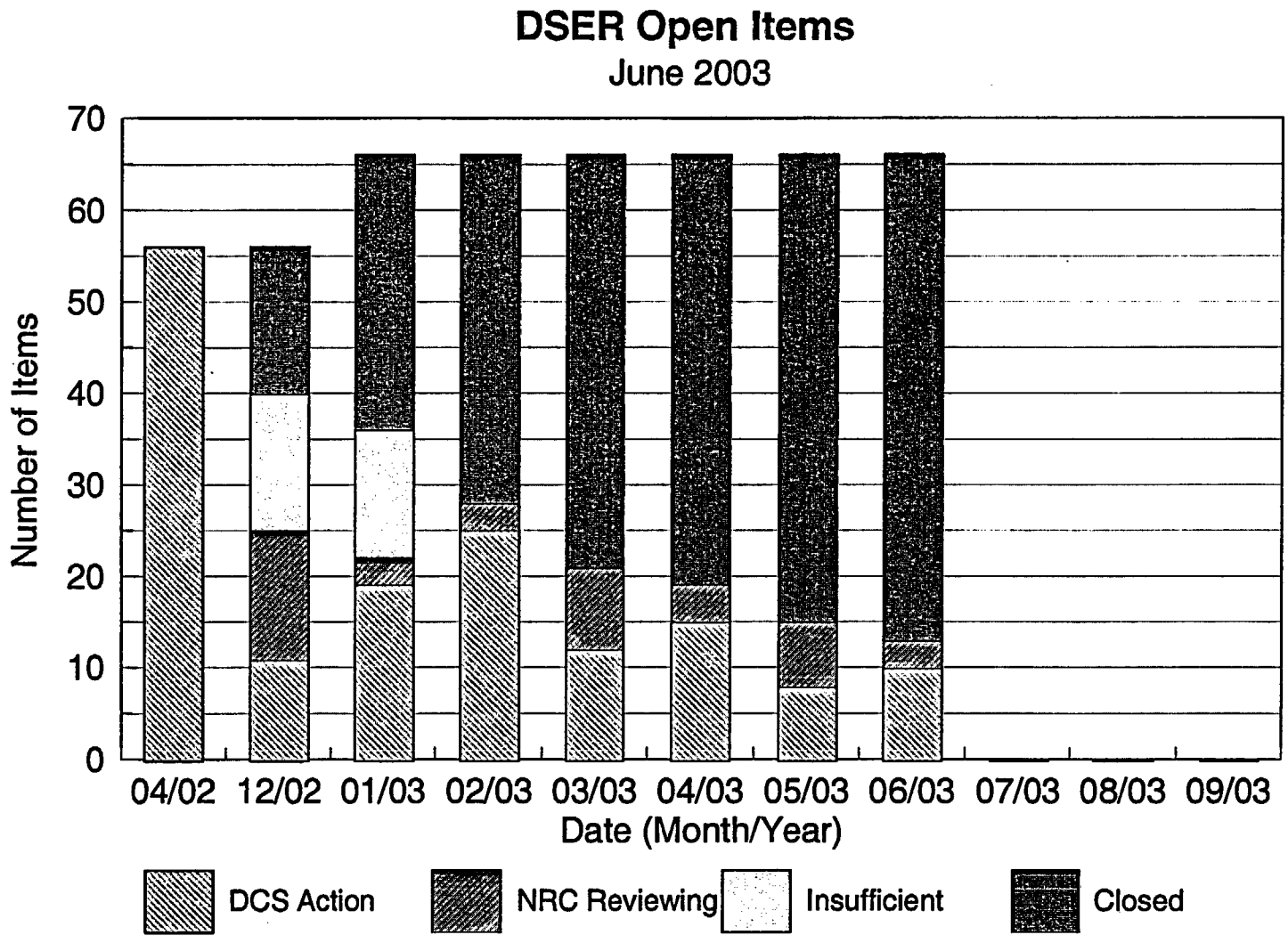
Andrew Persinko, Sr. Project Manager
NMSS/FCSS/SPIB

Remaining Open Items

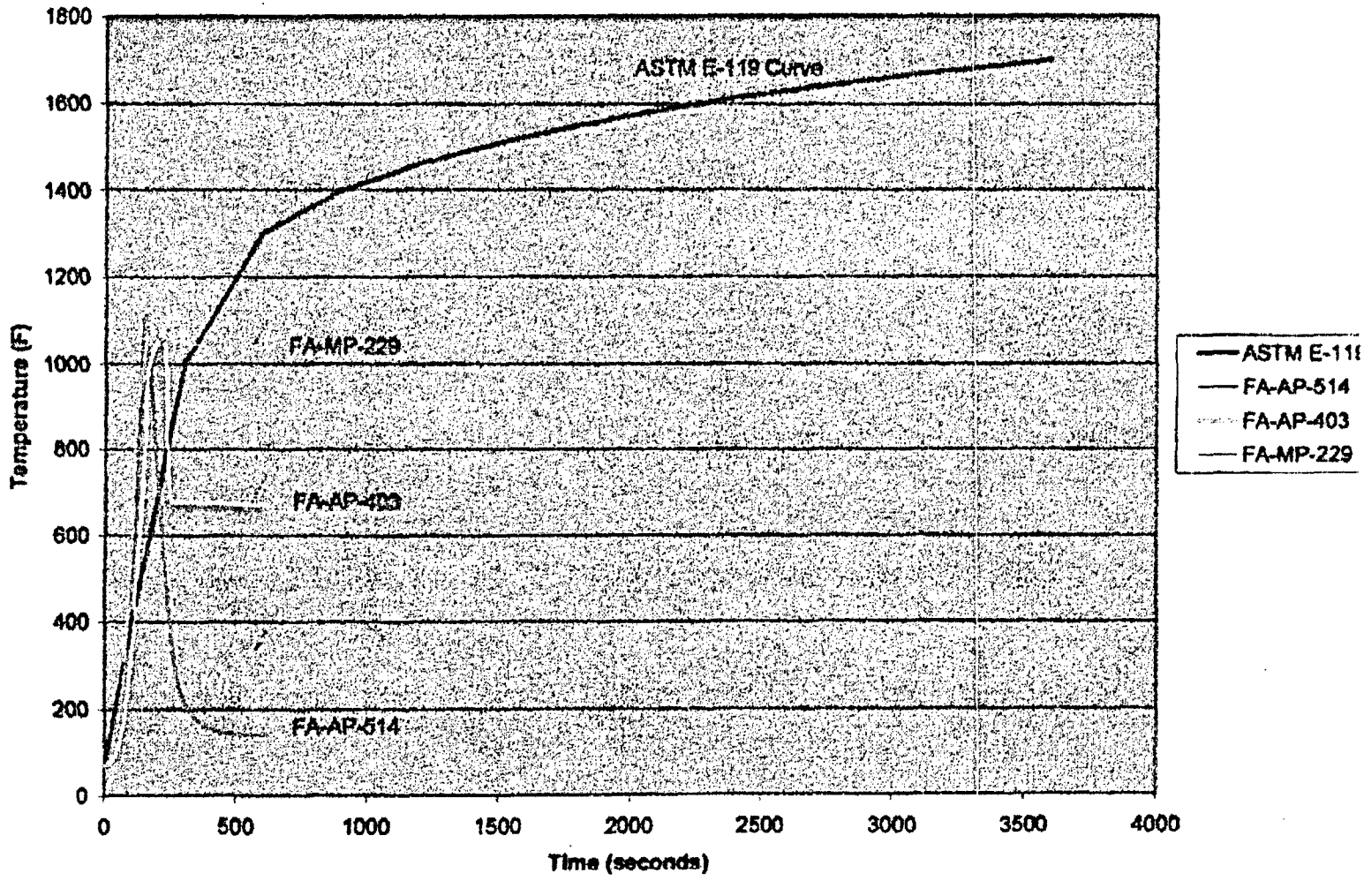
- Titanium fires (AP-3)
- UO_2 burnback (MP-1) Hydroxylamine nitrate (HAN)/hydrazine (CS-2)
- Design basis for flammable gases: lower flammabilty limit values 25% vs 50%
  - Solvent temperatures (CS-9, AP-9)
  - Electrolyzer (AP-2)
  - Offgas unit (AP-8)

Remaining Open Items

- Emergency control room habitability limits (CS-10)
- Use of Temporary Emergency Exposure Limits (TEELs) (CS-5b)


DSER Open Items
June 2003
Number of Items
70
60
50
40
30
20
10
0
04/02
12/02
01/03
02/03
03/03
04/03
05/03
06/03
07/03
08/03
09/03
Date (Month/Year)
DCS Action
NRC Reviewing
Insufficient
Closed

Worst-Case Simulations - FA-MP-229, FA-AP-403, and FA-AP-514



DUKE COGEMA
STONE & WEBSTER

MFFF
General Facility Mission and Layout

Presentation to the

504th Advisory Committee on Reactor Safeguards

10 July 2003

DUKE COGEMA
STONE & WEBSTER

MFFF Mission

- To irreversibly transform 34 metric tons of excess weapons plutonium into a form unusable for weapons
  - MOX Fuel Fabrication Facility - Fabricate plutonium oxide powder into mixed oxide fuel assemblies

DUKE COGEMA
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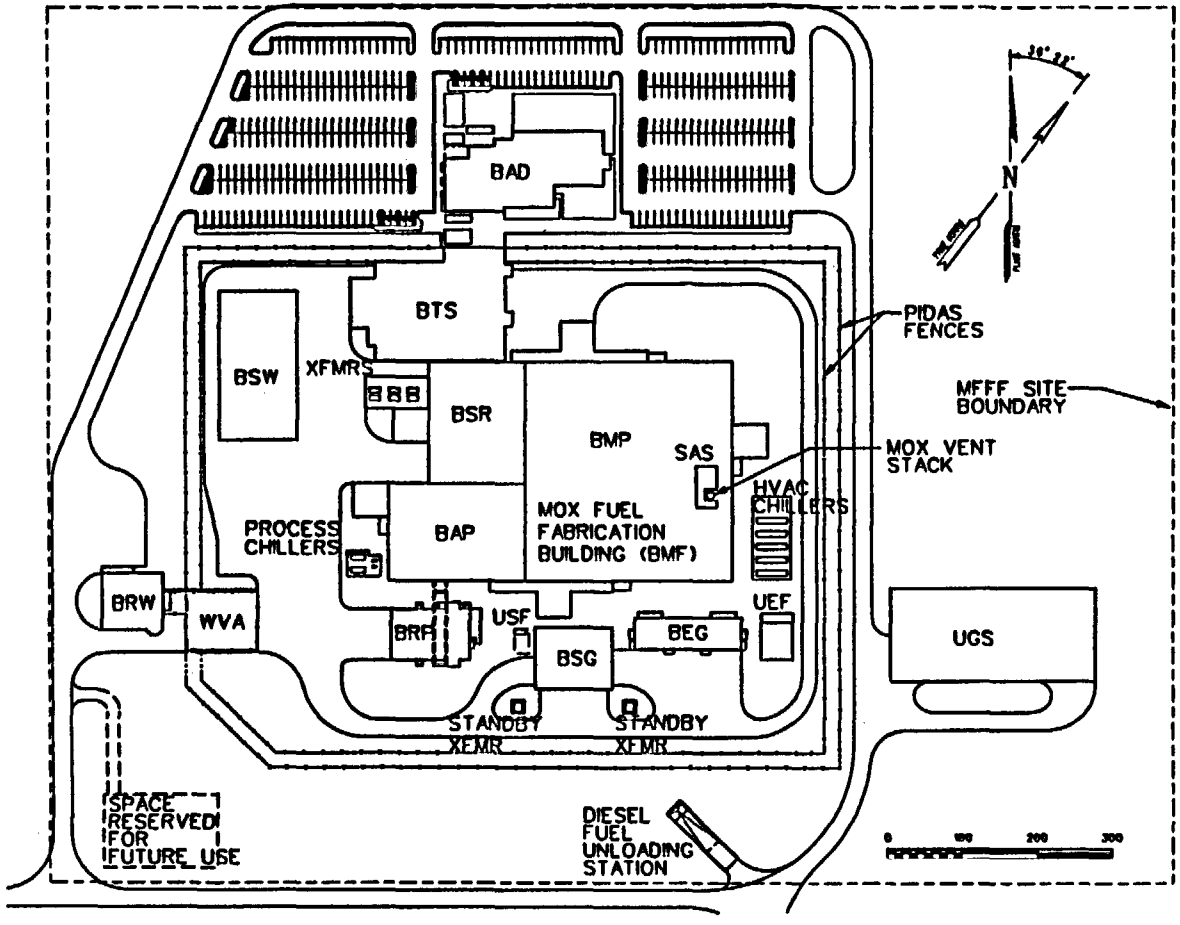
MOX Facility Layout



- **BUILDING LEGEND**
  - **MOX FUEL FABRICATION BUILDING (BMF)**
    - **BMP- MOX Processing Area**
    - **BAP- Aqueous Polishing Area**
    - **BSR- Shipping and Receiving Area**
  - **SUPPORT BUILDINGS**
    - **BTS- Technical Support Building**
    - **BRP- Reagents Processing Building**
    - **BAD- Administration Building**
    - **UGS- Gas Storage Area**
    - **BSW- Secured Warehouse Building**
    - **BEG-Emergency Generator Building**
    - **BRW- Receiving Warehouse Building**
    - **BSG- Standby Generator Building**
    - **WVA- Vehicle Access Portal**
    - **BRW- Receiving Warehouse Building**
    - **UEF- Emergency Fuel Storage Vault**

DUKE COGEMA
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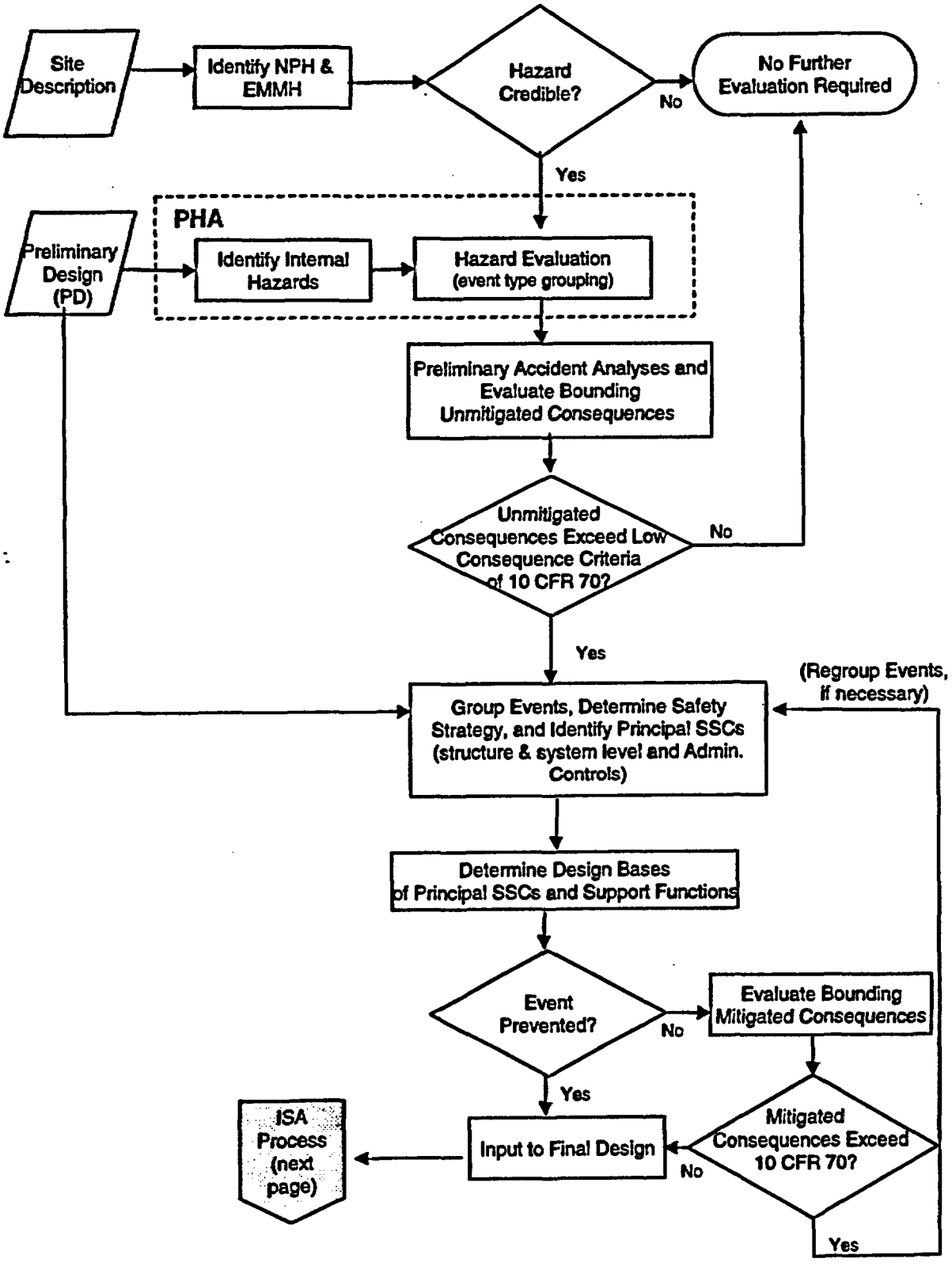
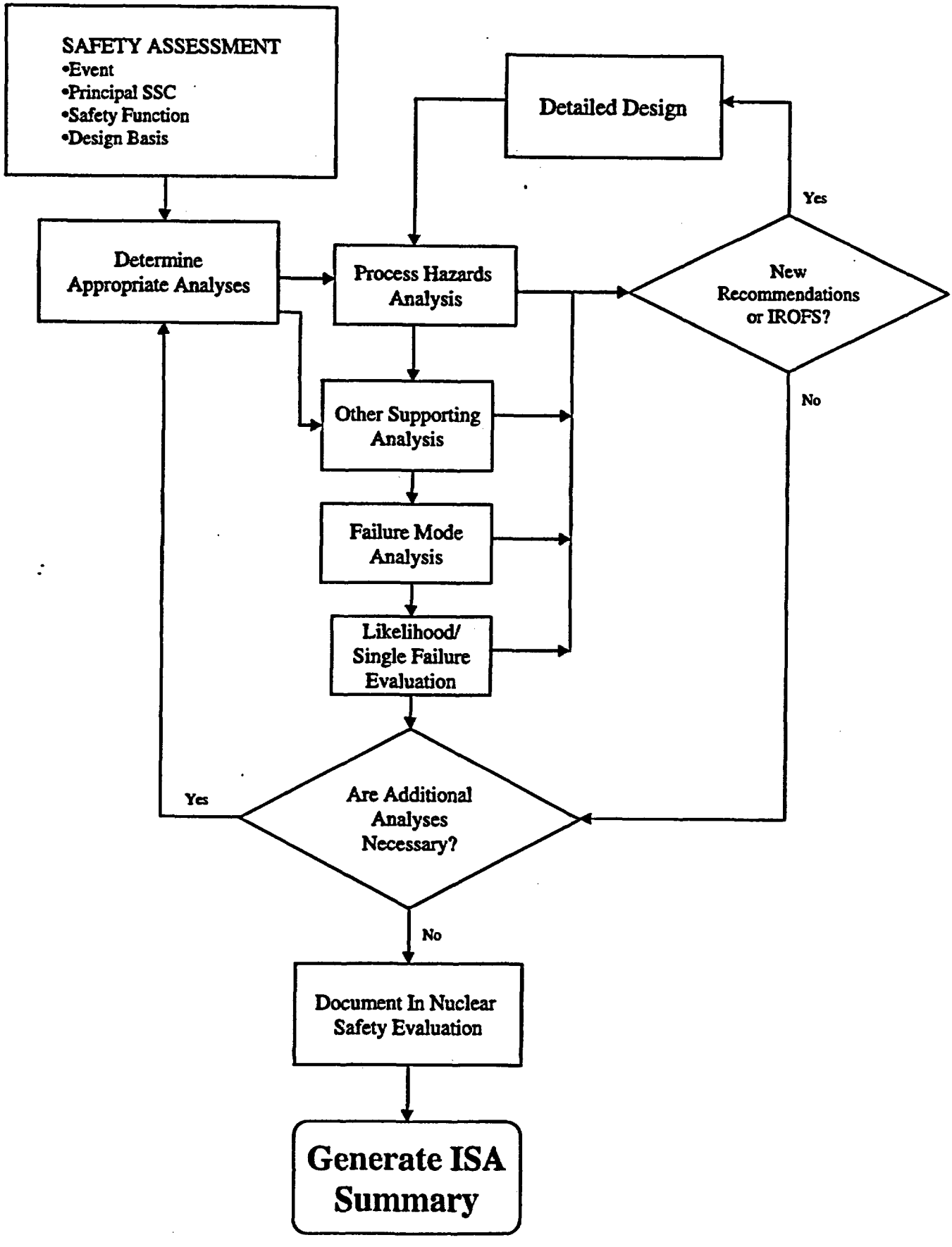
Safety Philosophy

ISA Flow Chart (Safety Assessment of the Design Basis)

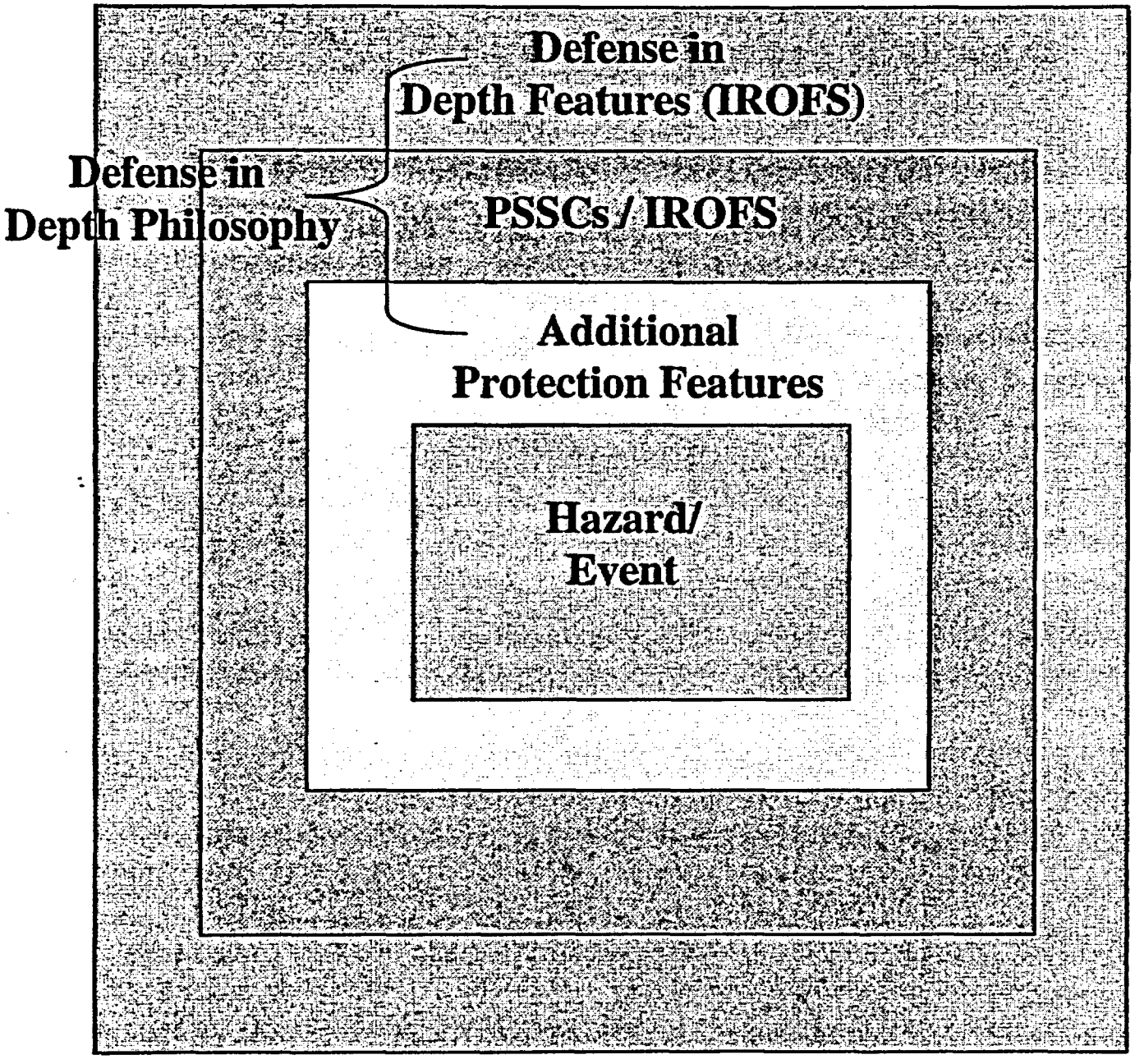


Continuation of ISA Process



ISA Terminology and Defense in Depth Philosophy

Public



Proposed Criteria for the Treatment of Individual Requirements in a Regulatory Analysis

Briefing to the ACRS

Brian J. Richter
Reactor Policy & Rulemaking Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation
July 10, 2003

Objective of Presentation

- Obtain ACRS consent on the staff's approach to the treatment of the "bundling" issue.
  - Given the proposed approach is improved over existing guidance, obtaining ACRS consent would allow implementation, via the issuance of the Regulatory Analysis Guidelines, Revision 4, to occur in a timely fashion.
- Obtain comments from ACRS to improve the proposed approach and, if needed, adapt additional input for a new revision (5) to the Guidelines.

Issue

- The Commission and others have raised the issue of the "bundling" of individual requirements into a single regulatory analysis.

- The concern is that the net benefit from one regulatory requirement could potentially support other requirements that are not cost-justified.

Background

- SECY-00-0198, "Status Report on Study of Risk-informed Changes to the Technical Requirements of 10 CFR Part 50 (Option 3) and Recommendations on Risk-Informed Changes to 10 CFR 50.44 (Combustible Gas Control)"
  - Staff recommended that the Commission not allow selective implementation of voluntary rules, as was suggested by some licensees.
  - Commission agreed, but challenged staff to establish a process solution.

Background (cont.)

- SECY-01-0134, "Final Rule Amending the Fitness-for-Duty Rule"
  - Stakeholders raised concerns with the NRC approach that "bundles" individual requirements into a single analysis.
  - SRM directed the staff to ensure that individual rule changes are integral to the purpose of the rule, cost-justified, or qualify as backfit exceptions.

Background (cont.)

- SECY-01-0162, "Staff Plans for Proceeding with the Risk-Informed Alternative to the Standards for Combustible Gas Control Systems in Light-Water-Cooled Power Reactors in 10 CFR 50.44"
  - Staff proposed to develop guidance to address how to assess new risk-informed requirements.
  - Commission agreed and directed the staff to ". . . [I]mplement a disciplined, meaningful, and scrutable methodology for evaluating the value-impact of any new requirements that could be added by a risk-informed alternative rule."

Staff Activity

- Working Group formed containing members from NRR, NMSS, RES, and OGC.
- Proposed revision to Regulatory Analysis Guidelines, NUREG/BR-0058, Rev. 3 to address the treatment of individual requirements.
- Published FRN February 13, 2002, which presented preliminary proposed criteria for the treatment of individual requirements in a regulatory analysis, and announced public meeting.
- Held public meeting on March 21, 2002, to discuss preliminary proposed criteria.
- Extensive comments were received at the meeting..
- Developed proposed guidance considering comments received.

Staff Activity (cont.)

- Obtained CRGR endorsement of proposed guidance.
- Staff obtained approval from the Commission to publish these proposed revisions to NUREG/BR-0058 for public comment in the *Federal Register*.
- SRM said staff should provide the final criteria to the Commission for review not only if the comments result in significant changes to the criteria, but also if there are significant adverse comments regarding the criteria.
- A request for comment on the proposed criteria was published in the *Federal Register* on April 18, 2003.

Published Proposed Criteria

- The proposed criteria were:
  - If an individual requirement is "necessary" (i.e., it is needed in order to meet the objectives of the rule or maintain consistency with Commission policies), it does not need to be analyzed separately.
  - If an individual requirement is supportive but not necessary, it should be included only if it makes the bundled initiative more cost-beneficial.

Published Proposed Criteria (cont.)

- If an individual requirement is unrelated to the overall regulatory action, it should be included only if it makes the bundled requirements more cost-beneficial *and* it passes the backfit test, if applicable.

- Disaggregation is only appropriate if it produces substantively different alternatives with potentially meaningful implications on the cost-benefit results.

- If an individual requirement in a voluntary rule is justifiable under backfit criteria, NRC should consider imposing this as a mandatory backfit.

Comments Received

- NEI made the only submittal of comments
  - Criteria necessary to evaluate the bundling of individual requirements into a single regulatory analysis.
    - Risk-informed voluntary alternatives should be cost-justified <u>and</u> integral, not cost-justified <u>or</u> integral.
    - Lack of scrutable guidance by the NRC.
  - Use of subjective judgment in making bundling decisions.
  - Request another public meeting on the issue.

Future Actions

- Working group to meet to resolve NEI comments and requests.
- Management is considering whether to hold another public meeting.
- Draft revised Guidelines input and submit to the Commission.
- Issue NUREG/BR-0058, Rev. 4.

GE Nuclear Energy

ESBWR Design Overview and Technology Closure

Atam Rao
Project Manager ESBWR
GE Nuclear Energy, USA

ACRS Meeting
July 10, 2003,
Rockville, Maryland

Outline

- ESBWR Program Overview
  - stepwise program with Technology Closure as first step
- ESBWR Design Overview
  - simpler with more margin – by design
  - comprehensive testing and analysis program
- Technology program
  - comprehensive plan with complete implementation
  - testing and qualification
  - single integrated computer code for analysis with well defined application methodology
- Technology Closure Program – pre-application review
  - safety evaluation report for TRACG
- Summary and Conclusions

A simple design, extensive testing and analysis – Implementing an action plan to minimize regulatory risk

ESBWR Program overview

- Stepwise program for design development
  - Developed passive systems
  - Developed integrated plant design – SBWR
    - Completed extensive system and building design
    - Defined extensive test and analysis program
    - Completed extensive test and analysis program
  - Improved plant economics and design
    - Plant optimization and economies of scale
    - Incorporated utility requirements
    - Utilize ABWR experience – components, construction
- Stepwise program for regulatory approval
  - Simpler with more margin – by design
  - Technology Closure Program – pre-application review
    - safety evaluation report for TRACG
    - focus on safety systems & containment
    - use of single integrated computer code for analysis
    - comprehensive testing and analysis basis
  - Safety analysis report & design certification – after technology closure

GE is committed to develop and license the ESBWR

Goals for the technology closure

- Approval of the use of TRACG for analysis
  - vessel response to pipe break – loss of coolant accident (called ECCS/LOCA)
  - containment response to pipe break (called Containment/LOCA)
  - vessel response to anticipated operational occurrences (called AOO) - delayed
  - plant response to anticipated transients without scram (ATWS) and normal operation stability (ODYSY) – LATER
- Confirmation of the adequacy of TRACG
  - adequacy of the qualification base and approach

Is a 15+ year comprehensive technology program enough?

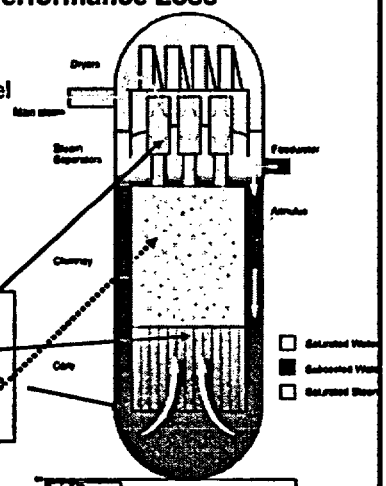
Comparison of Key ESBWR Parameters to Operating BWRs

Parameter	BWR/4-Mk I (Browns Ferry 3)	BWR/6-Mk III (Grand Gulf)	ABWR	ESBWR
Power (MWt/MWe)	3293/1098	3900/1360	3926/1350	4000/1390
Vessel height/dia. (m)	21.9/6.4	21.8/6.4	21.1/7.1	27.7/7.1
Fuel Bundles (number)	764	800	872	1020
Active Fuel Height (m)	3.7	3.7	3.7	3.0
Power density (kw/l)	50	54.2	51	54
Recirculation pumps	2(large)	2(large)	10	zero
Number of CRDs/type	185/LP	193/LP	205/FM	121/FM
Safety system pumps	9	9	18	zero
Safety diesel generator	2	3	3	zero
Core damage freq./yr	1E-5	1E-6	1E-7	1E-7
Safety Bldg Vol (m^3/MWe)	115	150	160	70

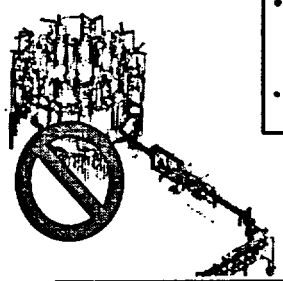
Evolution Within a Small Range Minimizes Operational Risks

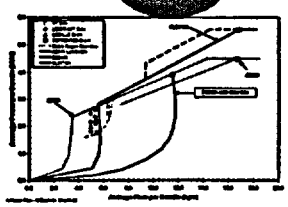
Natural Circulation – Simplification Without Performance Loss

- **Passive safety/natural circulation**
  - Put the water in the vessel – larger vessel
  - Increase driving head – larger vessel
- **Significant reduction in components**
  - Pumps, motors, controls, HXers
- **Load following with Control Rod Drives**
  - Minimal impact on maintenance



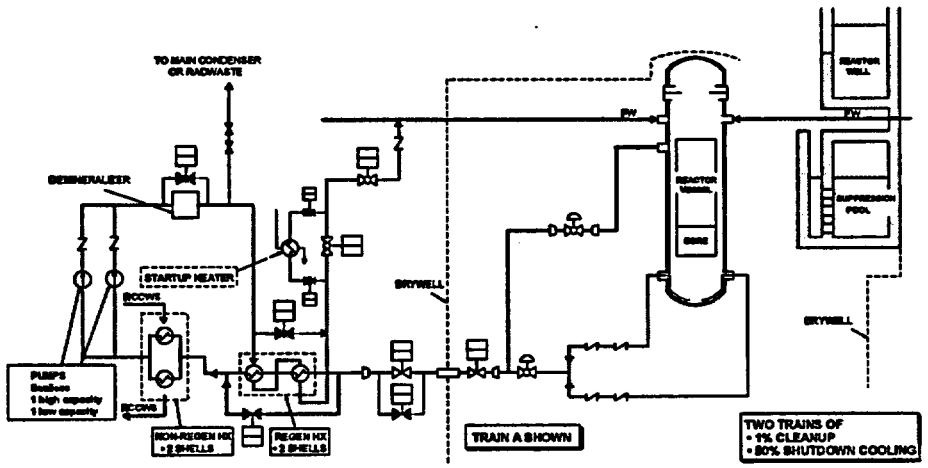
- Reduced flow restrictions
  - Improved separators
  - Shorter core
  - Increase downcomer area
- Higher driving head
  - Chimney/taller vessel





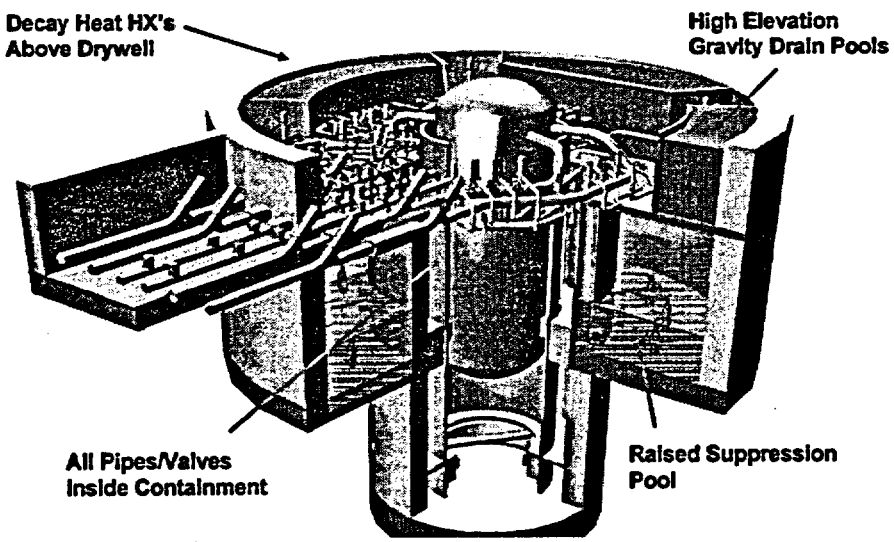
Enhanced Natural Circulation Compared to Standard BWR's

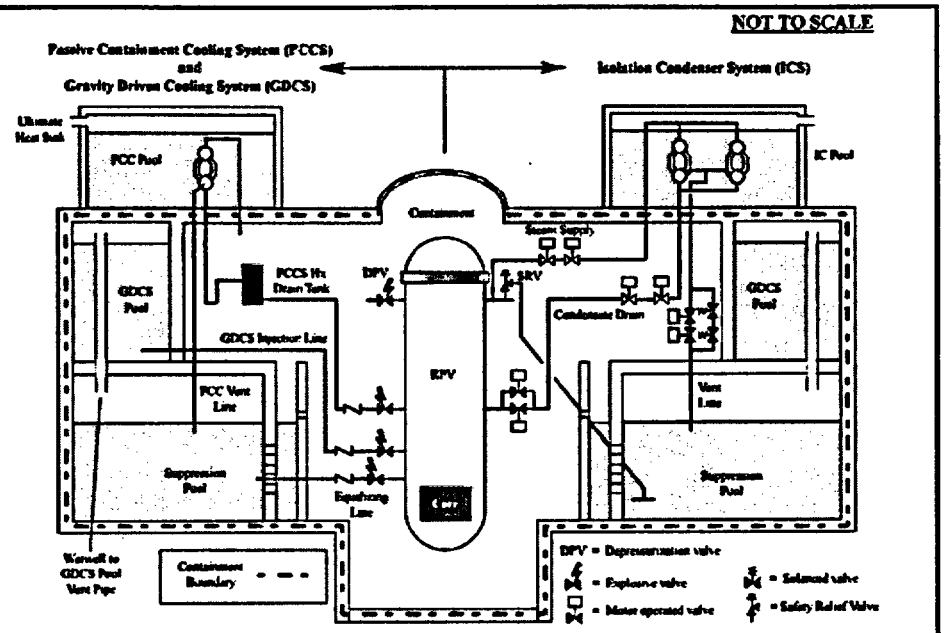
Reactor Water Cleanup / Shutdown Cooling System
(both systems combined for ESBWR)



Standard 2 x1% reactor water cleanup system with Unique full pressure shutdown cooling system

Passive Safety Systems Within Containment Envelope





Passive systems simplify the plant, reduce maintenance & increase security

AR-9

Design philosophy for core cooling

- **Increase inventory in the vessel**
  - Use taller vessel - NEW
  - Increase amount of subcooled water - NEW
- **Minimize inventory loss from the vessel**
  - Eliminate large pipes below the core and minimize other pipes - NEW
- **Keep core covered after initial blowdown**
  - Shorter core lower in the vessel - - NEW
- **Provide inventory makeup – low head using gravity**
  - Provide diverse depressurization system for high reliability - NEW
  - Required makeup rate is very low
    - Multiple pools rely on gravity to fill vessel - NEW
  - No high capacity systems needed
  - Fewer systems interactions
- **Utilize integrated BWR analyses tools**

Design features improved the plant response

AR-10

Design Philosophy for decay heat removal

- **Remove Decay Heat From Vessel**
  - Main Condenser
  - Full pressure normal shutdown cooling system - NEW
  - Isolation condensers - NEW
  - Remove vessel heat through relief valve opening
- **If Needed, Remove Heat From Containment**
  - Passive containment cooling (PCC) Hx (safety-grade) - NEW
    - Always available and drywell/wetwell pressure difference removes the non-condensables from the heat exchangers
    - Condensed steam returns to drywell/vessel, non-condensables collect in the wetwell airspace
    - No operator action needed for 72 hours
  - Suppression pool cooling (non-safety)

Several Diverse Means of Decay Heat Removal

AR-11

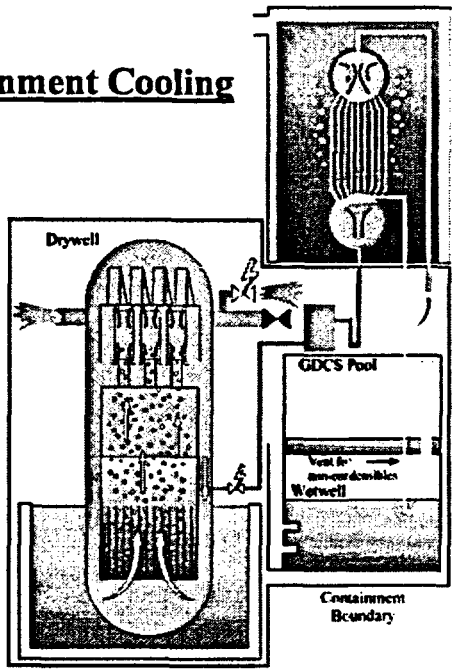
Decay Heat Removal from Containment - How it works

- **Initially steam (blowdown energy) flows to large heat sink in containment (suppression pool) and through heat exchangers**
- **Longer term (decay heat) steam flows to heat exchanger (similar to an isolation condenser) and heat is transferred outside containment**
  - vertical tube heat exchangers in a pool of water
  - non condensables removed by pressure difference between drywell and wetwell
- **Containment pressure determined by non-condensables in wetwell airspace and vapor pressure**

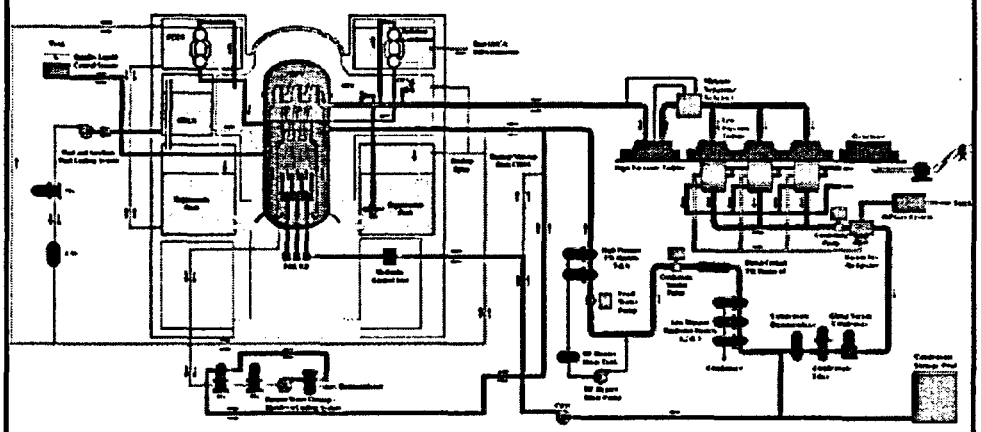
Concept is simple, reliable - extensive testing and analysis provide high confidence in the design margin

AR-12

Passive Containment Cooling

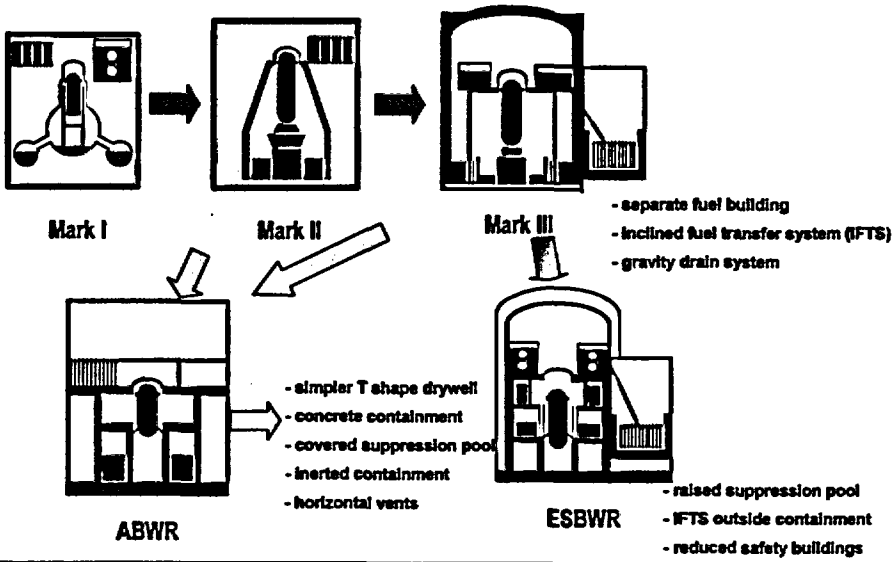


ESBWR Plant Schematic

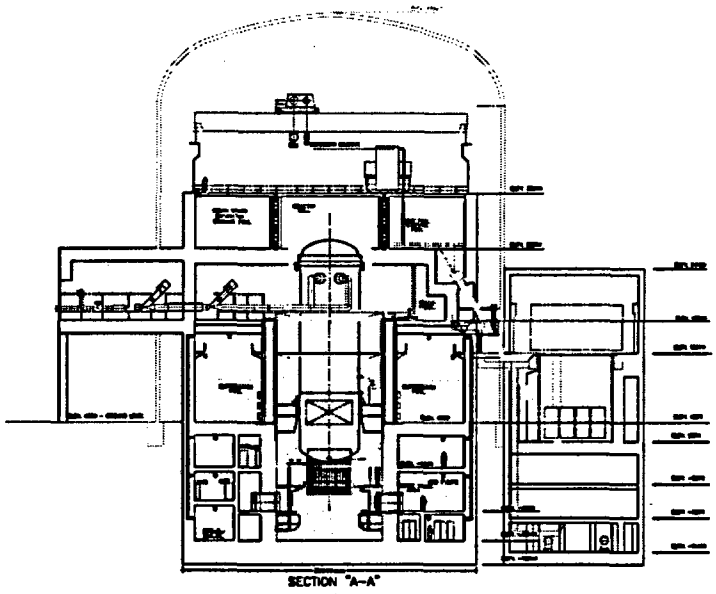


A Typical but Simpler Direct Cycle Plant

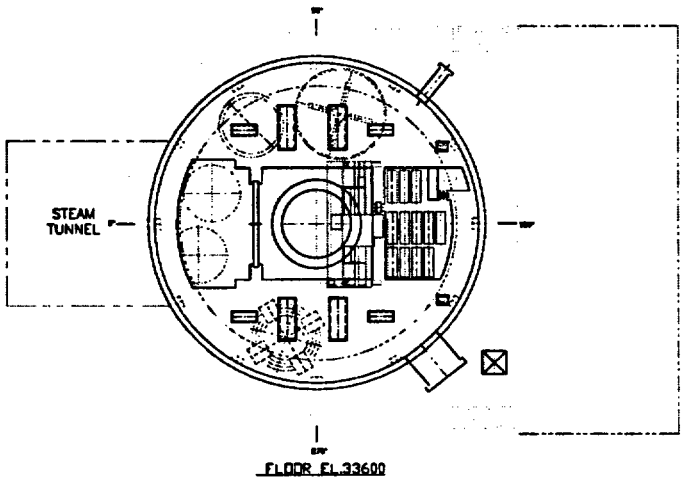
Evolution of BWR Containments and Reactor Buildings



Evolution and Innovation Towards Simplicity



Smaller structures – less equipment with good access
Separate fuel building and improved security



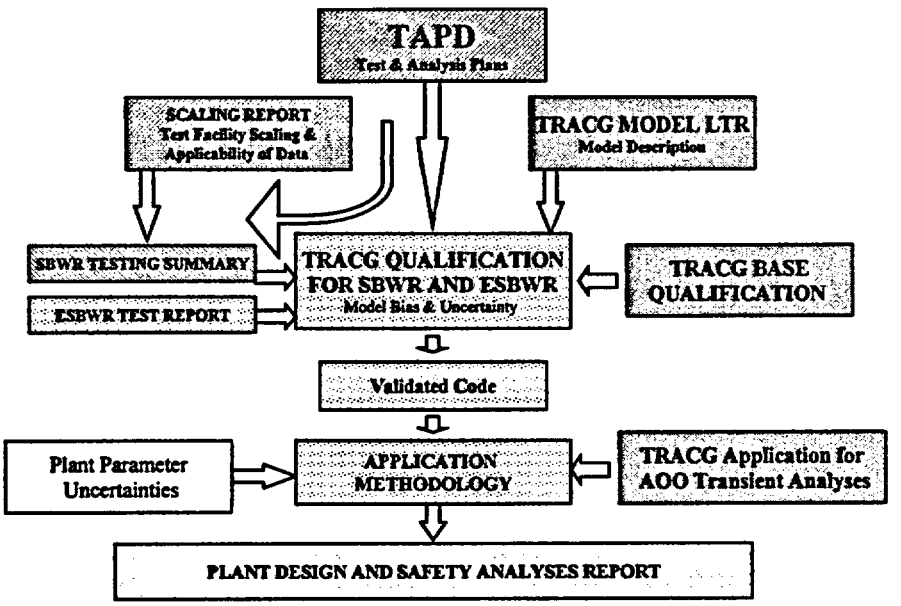
Refueling floor arrangement controls building size.
Improved fuel storage and transfer system

ESBWR and BWR Analysis Methods

Analysis Type	Analysis Method	
	BWR	*ESBWR*
Steady state	ISCOR	ISCOR
Transients		
· Pressurization	TRACG	TRACG
· Loss of feedwater heating	PANACEA	PANACEA
ATWS	ODYN/TASC	TRACG
Stability	ODYSY/TRACG	ODYSY/TRACG
LOCA/ECCS	SAFER	TRACG
LOCA/containment		
· Pressure/temperature response	M3CPT/SUPERHEX	TRACG
· Loads	Approved Methodology	Approved Methodology

TRACG – an integrated proven code - used for most analysis for ESBWR

ESBWR Technology Program Elements



Strategy for Determination of Test & Analysis Needs

- Develop list of governing phenomena and system interactions
- Top-Down Process based on plant accident/transient scenarios
  - Determine key phases of transients
  - List potentially important phenomena
  - Expert group ranking phenomena (PIRT)
- Bottom-Up process based on all unique ESBWR design features
  - Determine associated phenomena/system interactions
  - Evaluate and rank issues by importance
  - Supplements PIRT ranking approach to fill any gaps by focusing on ESBWR-unique features
- Consolidate highly ranked phenomena and system interactions
- Evaluate capability of analysis models & testing plans
  - Implement any needed models or bounding modeling procedures
  - Fill in testing gaps
  - Evaluate uncertainties to establish appropriate design margins

Rigorous process followed to define technology plan

Differences between ESBWR and SBWR

- Power Increased
  - Steamlines increased to 4 vs 2
  - 1020 bundles of 3 m height
    - F-lattice core design with wide span control blades
  - Isolation condensers (IC) capacity increased by 50%
  - Passive condenser (PCCS) capacity increased by 80%
    - 4 vs 3 units of 13.5MW/unit vs 10MW/per unit
- Plants systems and buildings
  - System sizes and capacities increased but not numbers
  - Utilize gravity drain system (GDCS) pool draindown space to provide increased wetwell volume (~15%)
  - Major building optimization incl. transfer of non safety systems and spent fuel storage

Differences do not affect governing phenomena (PIRT) for normal operation, transients and accidents

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Overview of Passive Plant Test Programs

- **Component Tests**

PANTHERS/PCC (FULL SCALE)
Full-scale prototype performance tests
Steady state and transient tests with heavy (air) and light (helium) noncondensibles

PANTHERS/IC
One of two modules of a full scale unit
Steady state, startup and transient tests

PANDA PCC Tests (S Series) (1/50scale)
10 steady state tests

DPV Tests (FULL SCALE)
Performance tests of prototype valve

Vacuum Breaker Tests
Performance tests of prototype valve

- **Integral System Tests**

GIST (1/1000 scale)
26 ECCS/LOCA integral tests with GDCS from wetwell pool

GIRAFFE Step 3 (1/800 scale)
Long term containment response

GIRAFFE/Helium (1/800 scale)
Long term containment response with light noncondensible gas

GIRAFFE/SIT (1/800 scale)
ECCS/LOCA and containment integral tests with SBWR configuration (GDCS pool in drywell)

PANDA (1/50 scale) M Series
Long term containment response

Extensive tests at different scales in different facilities

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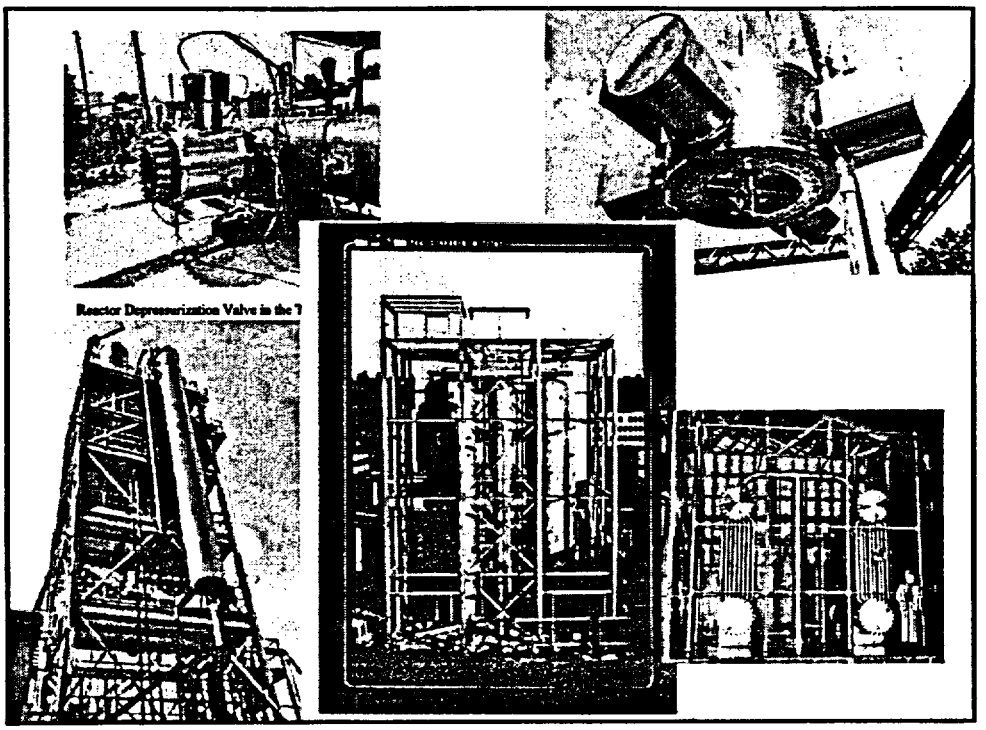
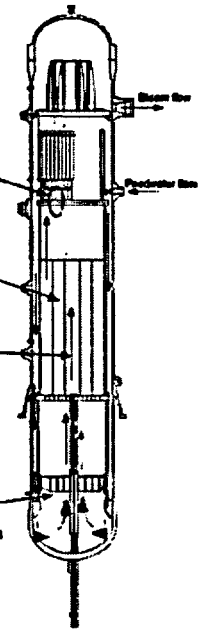


Other Applicable Test Programs

- **CRIEPI Natural Circulation Stability Tests**
  Thermal-hydraulic stability tests of natural circulation loop
- **Dodewaard Plant Startup**
  Natural circulation plant startup
- **PSTF Mark III**
  Containment Early Blowdown Response
  Suppression Pool Stratification
- **Mark II 4T**
  Containment Early Blowdown Response
- **1/6 Scale Boron Mixing Test**
  Measurements of "boron" concentration in scaled regions of a BWR
- **PANDA P-Series Program** (performed after SBWR program was terminated)
  Integral System LOCA Test with ESBWR configuration (~1/50 scale)
  Tests of Long Term Containment Response and late GDCS period
  Tests include release of lighter-than-steam gas (Helium)
- **CRIEPI High Pressure Stability Tests** (performed after SBWR program was terminated)
  Thermal hydraulic stability tests with natural circulation loop

Natural Circulation Technology Program



Separator Performance
ATLAS Tests - AS2B
- smooth inlet geometry
- reduced pitch
  (305 mm -> 292 mm)

Chimney Void Fraction
Ontario Hydro Tests
- transient test (pump induced)
- round pipe (0.516 m ID)
- relatively flat void distribution

Startup Flow Oscillation
CRIEPI Tests
- single chimney
- SBWR conditions
- large margin to oscillation regime
Dodewaard Plant Start-up

Mixing
1/6 Scale Boron Injection
- low pressure
- salt simulant

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Containment and Safety Systems Technology

SBWR	Confirmatory Tests

Condensation with N/C
MIT - external condensation
UCB - single tube tests
GIRAFFE - component tests
PANTHERS - component tests
PANDA - steady state tests

PCCS Performance
Steady-state: PANDA, GIRAFFE, PANTHERS
Start-up: PANDA, GIRAFFE
Secondary Side Ht: PANDA, PANTHERS, GIRAFFE
N/C Buildup: PANDA, PANTHERS, GIRAFFE
Interactions: PANDA
Unit interactions PANDA

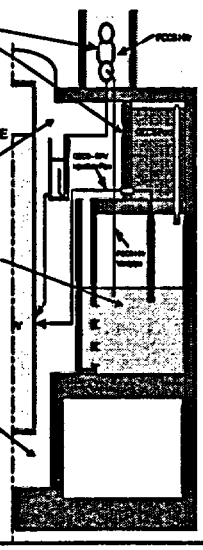
System Interactions
PANDA
GIRAFFE

SP Stratification
PANDA
SP Stratification

DW Stratification and Blowout
PANDA
GIRAFFE

Steam Quenching
Main Vent:
-Horiz. Vent Test/MK III tests (PSTF)
-Mark II 4T
PCC Vent:
- PANDA

Heat/Mass Leakage DW to WW
VB Testing



PCCS Performance
PANDA-P series
- startup
- interactions
- secondary side ht
- N/C Buildup
- Unit interactions

RSBWR Configuration
PANDA -P series
- reduced cont. volume
- GDCS in WW
- PCCS Condensate to RPV

DW Stratification and Blowout
PANDA-P series
- Asymmetric loading
- hydrogen

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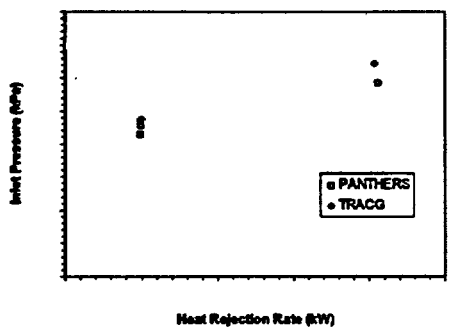
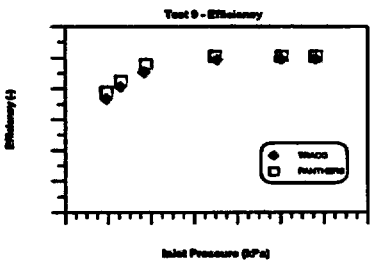
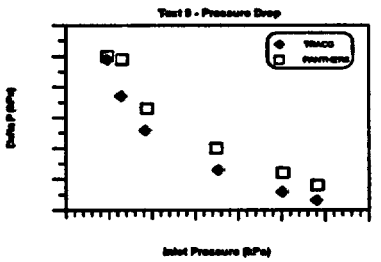
TRACG comparisons for PANTHERS PCC Tests - with & w/o non-condensibles







TRACG predicts component tests accurately for different test conditions

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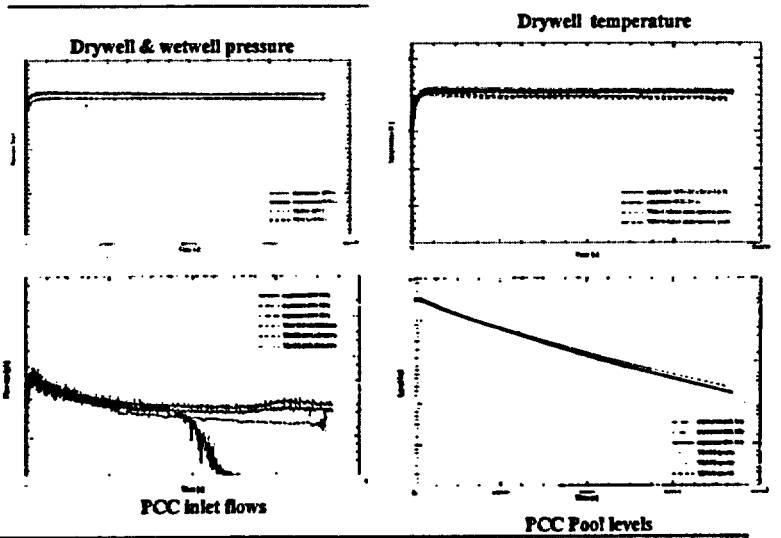
TRACG comparison to PANDA Test M3



TRACG predicts figure of merit and details accurately

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TRACG Qualification Summary

- All qualification activities identified in test and analysis plan have been satisfactorily completed
  - "generic qualification" studies have been reviewed and accepted by NRC for AOOs for operating plants
  - Significant additional qualification has been performed, particularly for long term containment response
  - Accuracy of models has been quantified for prediction of key parameters
- Model limitations have been identified and bounding approaches developed to treat these limitations
- TRACG is qualified for passive BWR (SBWR/ESBWR) analysis with appropriate application procedures

A comprehensive qualification program has been completed

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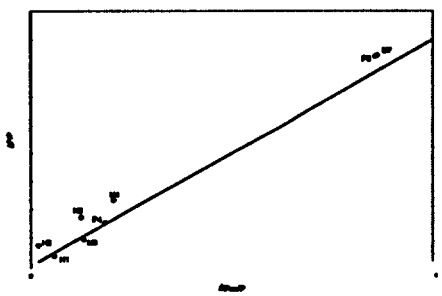
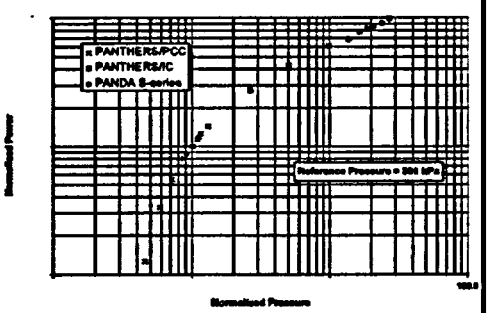
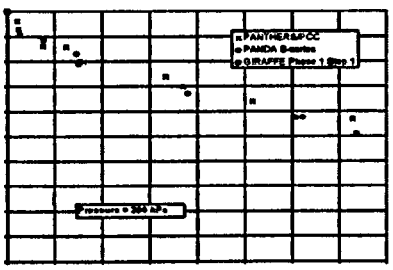
Effect of Scale on test results







- PCC/IC's are Readily Scalable
  - PANDA IC/PCC is a section of PANTHERS IC/PCC
  - PANTHERS PCC is a slice of ESBWR PCC
  - GIRAFFE PCC has different header configuration
- Containment pressure varies with non-condensable gas quantity in wetwell for different scales and different gases

Tests at different scale show similar results

ESBWR Technology Program Summary

- Passive safety systems have simplified the plant design
- Plant evaluations are simpler
  - Less complex analyses
    - Realistic calc. with uncertainties defined as for operating plants - AOO
    - Realistic calc. with simplified accounting of uncertainties – ECCS/LOCA
    - Conservative calculation for containment/LOCA
  - Low parameter uncertainty
  - Substantial margins exist in the design
  - Improved integrated code shows better performance
  - Defense in depth systems provide additional back-up
- Extensive qualification of TRACG
- Technology issues extensively studied

Performance improved by design features
Improved performance measured by qualified methods

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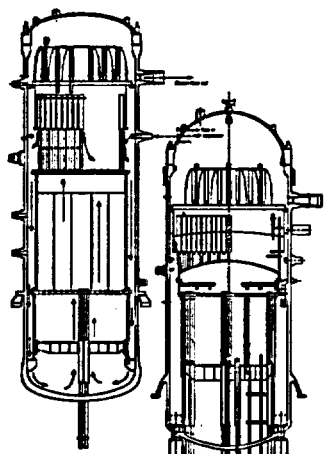
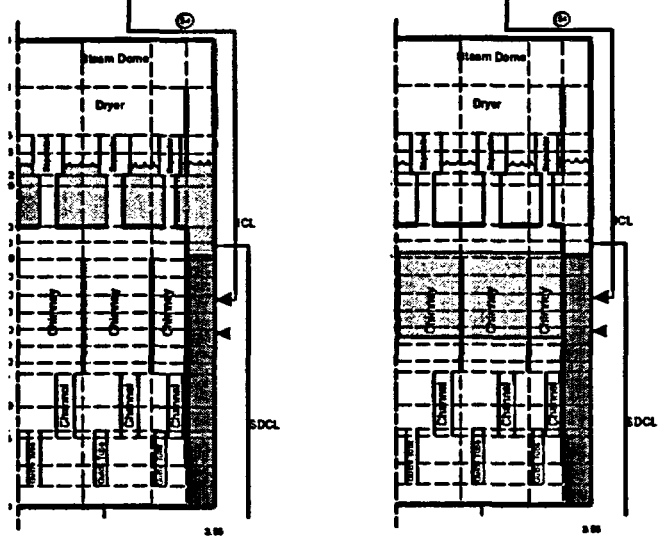
Design Features Affecting Plant Response

	ESBWR	ABWR	BWR5	BWR4
Large pipes below core	No	No	Yes	Yes
Core height, m	3.05	3.66	~3.66	~3.66
TAF above RPV bottom	~ 1/4	~ 1/2	~1/2	~1/2
Separator standpipes	Long	Short	Short	Short
Vessel height, m	27.7	21.1	~21.9	~21.8
Water volume outside shroud (above TAF), m^3	222	88	94	92



Greater water inventory - improved plant LOCA performance
Larger steam volume – improved transient performance

Substantial Initial Water Inventory inside RPV



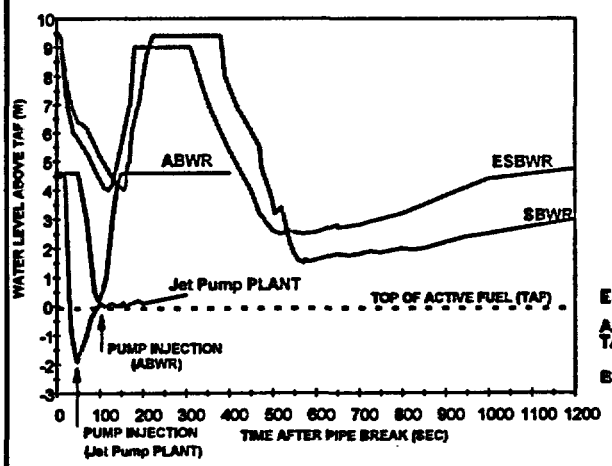
Collasped Levels at time = 0.0 sec

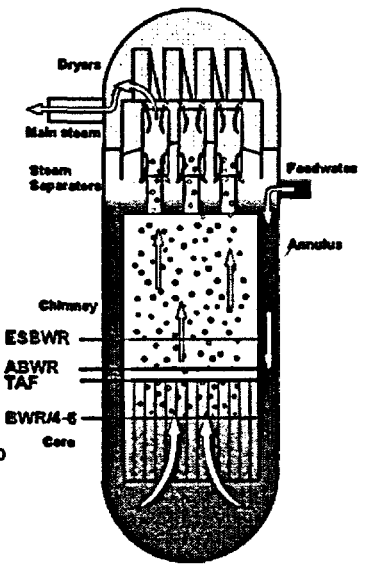
Collasped Levels at time ~ 20.0 sec

RPV Inventory Distribution Immediately following a LOCA

Water Level in Shroud Following a Typical Pipe Break

(values are intended to show typical trends for limiting breaks)

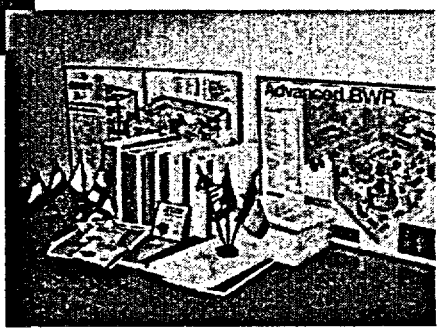




ESBWR Margins are Increased Over Past Plants

ESBWR Design/Technology based on SBWR and ABWR

Extensive new submittals



Extensive SBWR submittals and reviews, new test data and reports, coupled with design changes to add margin

Current status and near term deadlines

- **Extensive submittals made to NRC in 2002**
  - several meetings, conference calls and interactions
  - Extensive and thorough review by staff w 300+ RAI's
  - Final GE responses due by August 15, 2003
  - DSER for TRACG application due mid October
  - Additional application submittals covering AOO, ATWS and stability due over the next 6+ months
- **Preparation of SAR and certification**
  - Complete plant design optimization and SAR
  - Expected FDA 24 months after submittal
- **Challenges for the coming months**
  - Ensure GE responses are timely and complete
  - Complete technology closure (TRACG SER) with no open items

ESBWR Program Summary and Conclusion

- **15+ year technology and design program**
  - a BWR with less components
- **Simplification and margins by design**
  - large vessel results in benign response
  - analysis is simplified
- **Challenges for the coming months**
  - need closure and confirmation that regulatory risk is manageable

Expert Elicitation in Support of Risk-Informing 10 CFR 50.46

Robert L. Tregoning
Lee Abramson
US Nuclear Regulatory Commission

504th Advisory Committee on Reactor Safeguards Meeting
July 10, 2003

Previous ACRS Briefings and Program Milestones Since Last Briefing

- Previous ACRS briefings
  - May, 2002: Combined M&M, THP, R&PRA Subcommittee briefing on interim LOCA frequency elicitation and LOCA break size redefinition plans.
  - June, July, November, 2001: Overviews of LOCA frequency and break size redefinition effort provided to outline its importance within 10 CFR 50.46 revision framework.
  - March, 2001: Technical issues necessitating LOCA reevaluation.
- Program milestones Since May 2002
  - Selected expert panel and facilitation team.
  - Conducted kick-off meeting.
  - SRM Issued on SECY-02-0057 (Option III plan for risk-informing 10 CFR 50.46, Appendix K and GDC-35).
  - Conducted base case review meeting.
  - Held Public Meeting to discuss 10 CFR 50.46 effort: June 2003.

Expert Elicitation: Executive Summary

- Elicitation objective and approach are consistent with SRM guidance for development of near-term LOCA frequencies.
- Elicitation will develop LOCA frequencies as a function of leak rate and operating time considering both piping and non-piping contributions for all modes of plant operation.
- The conditional LOCA probabilities of larger, "emergency faulted" loadings are being estimated.
- Elicitation to combine aspects of group and individual elicitation approaches as appropriate to achieve objectives.
- Plans are in place to provide confirmatory analysis for the elicitation as well as develop a methodology for continually assessing LOCA challenges.

SRM Guidance

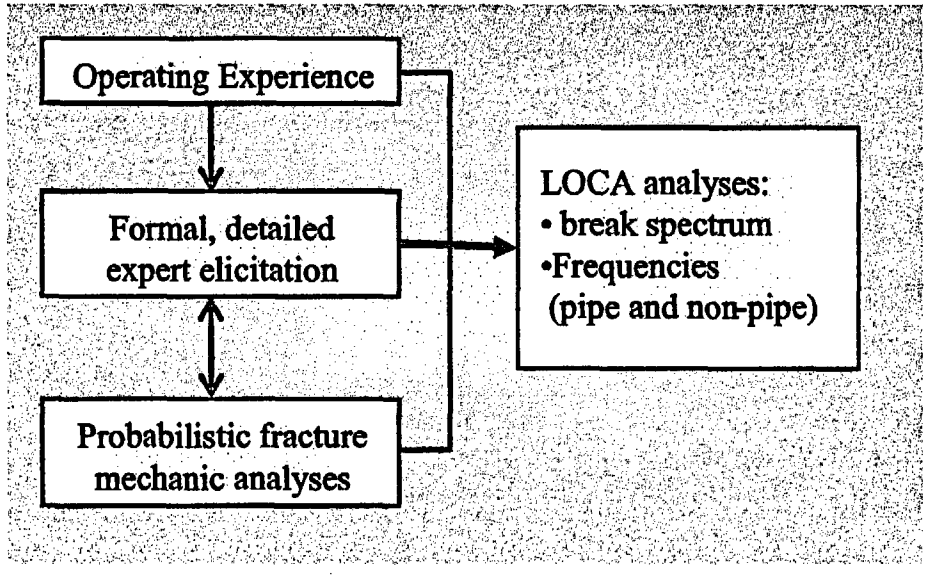
- The staff should conduct a practical reconciliation of LOCA frequency distributions by the 1) expert use of service-data, 2) Probabilistic Fracture Mechanics (PFM) and 3) expert elicitation to converge the results.
- Provide a comprehensive LOCA failure analysis and frequency estimation.
- Develop realistically conservative estimates, with appropriate margin for uncertainty.
- The staff should credit leak-before-break considerations only in conjunction with the establishment by a licensee of reliable and comprehensive means to detect primary system leaks of the relevant size.
- Use a 10-year period for the estimation of LOCA frequency distributions, with re-estimation every 10 years and review of new type of failures every 5 years.

General NRC Approach

1. **Operating Experience Assessment**
2. **Expert Elicitation.**
   - Re-evaluate LOCA frequencies.
   - Develop relationship between leak rate/break size and expected frequency for LOCA events.
   - Provide input to probabilistic LOCA computer code development.
3. **Probabilistic LOCA Code Development**
   - More rigorously combine operating experience and PFM insights.
   - Explicitly consider contributions from piping and non-piping components, and the evolution of new degradation mechanisms.
4. **Continual LOCA Assessment.**
   - Develop and maintain LOCA precursor database through expansion of existing pipe failure database.
   - Identify emerging degradation mechanisms and conduct anticipatory research to assess LOCA significance.

LB-LOCA Frequency Reevaluation

"The staff should conduct … expert elicitation to converge the results"



Value of Expert Elicitation

- Limitations of traditional approaches for LOCA frequency assessment.
  - Operating experience alone not sufficient to make future projections.
  - Probabilistic fracture mechanics (PFM) not sufficiently mature to model all system variables.
- Expert opinion (elicitation) is a formal process for providing quantitative estimates for the frequency of physical phenomena when the required data is sparse or when the subject is too complex to adequately model.
  - Data sparseness: no LOCAs have occurred.
  - Complexity is evident.
    - Many non-piping failure mechanisms.
    - Tremendous piping system variability.
- Elicitation has been used for similar problems.
  - Development of seismic hazard curves.
  - Performance assessments for high-level radioactive waste repository.
  - Determination of reactor pressure vessel flaw distributions.

General Elicitation Philosophy

- Use group assessment to develop base case conditions and frequencies. Conduct individual elicitations with respect to base case conditions and frequencies.
  - Assure common understanding of the base case.
  - Preserve independence and diversity of opinion.
- Conduct elicitation training.
  - Identify sources of motivational and cognitive biases.
  - Demonstrate value of elicitation process.
- Delay quantitative assessment until after panel discussion and issue analysis.
  - Ensure common understanding and clarity of issues.
  - Allow experts time to analyze issues.
- Require quantitative answers and rationale for mid, high, and low estimates.
  - Assess uncertainty
  - Ensure consistency among quantitative estimates.
  - Enhance understanding of LOCA frequencies contributing issues.
- Use facilitation team to guide elicitations.
  - Minimize motivational and cognitive biases.
  - Probe deeper into important issues.
  - Ensure comparable results among panel members.

Formal Elicitation Approach

- Select panel and facilitation team.
- Develop technical issues.
  - Define scope and objectives of elicitation.
  - Construct approach for determining LOCA frequencies.
  - Determine significant issues affecting LOCA frequencies.
- Quantify base case estimates.
  - Develop quantitative estimates for well-defined piping conditions.
  - Two estimates using PFM and two estimates from service history analysis.
- Formulate elicitation questions.
- Conduct individual elicitations.
- Analyze quantitative results and qualitative rationale.
- Summarize and document results.

Panel Selection Process

- Expert Panel.
  - Panel solicited from industry, academia, national laboratories, contracting agencies, other government agencies, and international agencies.
  - Panel members chosen to represent a range of relevant technical specialties: PFM, piping design, piping fabrication, operating experience, materials, degradation mechanisms, thermo hydraulics, operating mitigation practices, stress analysis, nondestructive evaluation, etc.
  - Initially started with a pool of 55 nominally qualified people supplied by a number of knowledgeable sources (incl. future panel members).
  - Solicited resumes from 25 people and asked them to judge their relevant technical areas of expertise.
  - Final panel of 12 chosen based on broad relevant expertise, and to ensure a diversity of opinion, expertise, and backgrounds.
- Facilitation Panel.
  - Comprised of normative and substantive experts.
  - Substantive experts chosen to provide relevant background knowledge.

Formal Elicitation Approach

- Select panel and facilitation team.
- **Develop technical issues.**
  - **Define scope and objectives of elicitation.**
  - **Construct approach for determining LOCA frequencies.**
  - **Determine significant issues affecting LOCA frequencies.**
- Quantify base case estimates.
  - Develop quantitative estimates for well-defined piping conditions.
  - Two estimates using PFM and two estimates from service history analysis.
- Formulate elicitation questions.
- Conduct individual elicitations.
- Analyze quantitative results and qualitative rationale.
- Summarize and document results.

Elicitation Scope and Objectives

- Develop piping and non-piping passive system LOCA frequencies as a function of leak rate and operating time up to the end of the license extension period.
- Determine LOCA frequency distributions for typical plant operational cycle and history including all modes of operation.
- Estimate condition LOCA probability distributions for rarer, emergency faulted load conditions.
  - Seismic loading.
  - Other large, unexpected internal and external loads.

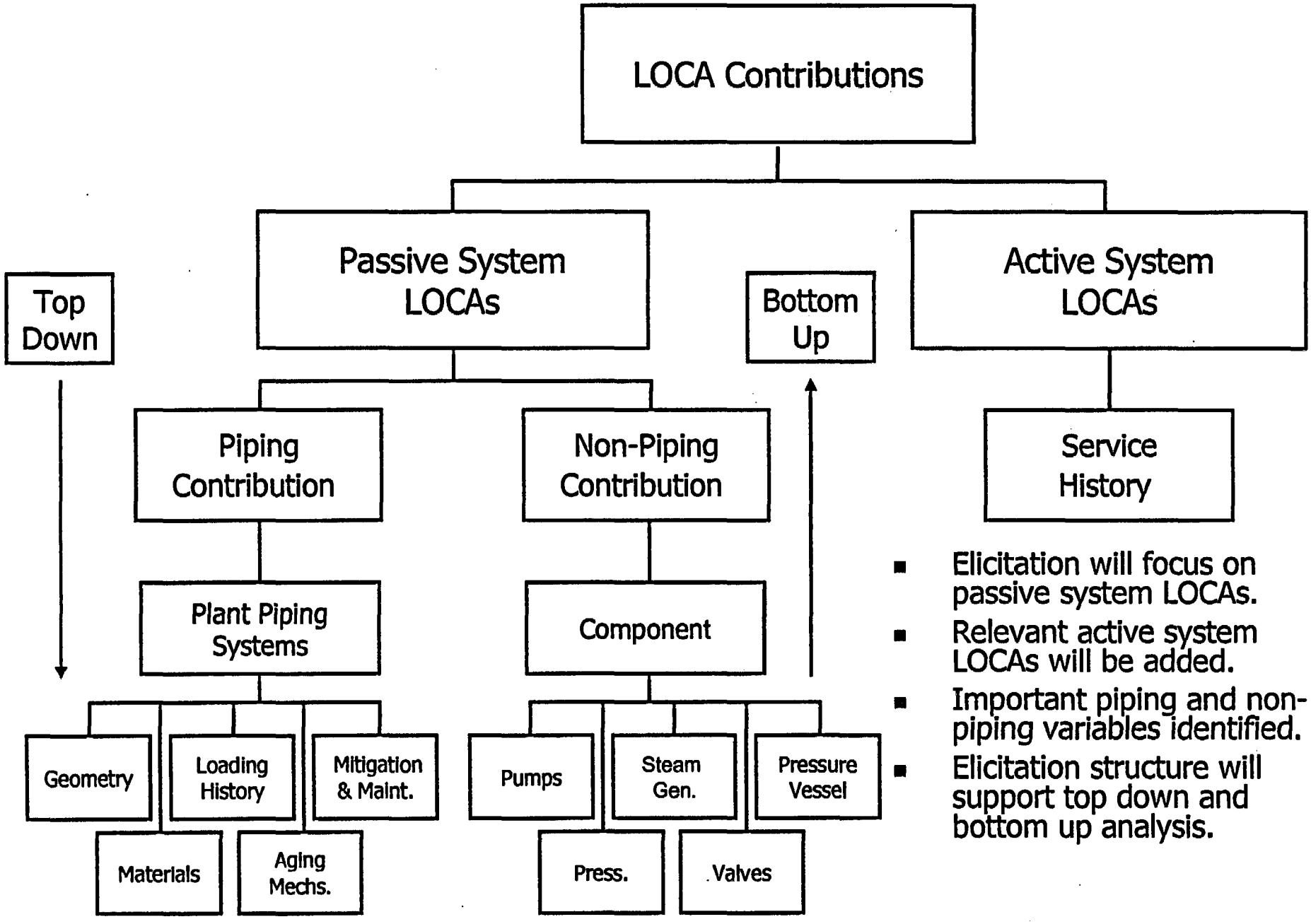
LOCA Sizes and Operating Time Periods Evaluated

- LOCA sizes based on leak rate to group plant system response characteristics.
- First three categories encompassed traditional definitions utilized in NUREG-1150 and NUREG/CR-5750.
- Three more LBLOCA categories added to examine trends with larger break sizes.
- Correlation between leak rate and break size developed for relevant BWR and PWR systems.

Category	Leak Rate Threshold (gpm)	LOCA Size
1	> 100	SB
2	> 1500	MB
3	> 5000	LB
4	> 25,000	LB a
5	> 100,000	LB b
6	> 500,000	LB c

- Three time periods evaluated.
  - Current (average 25 years of operating experience.
  - End of design life (40 years of operation).
  - End of life extension (60 years of operation).

General Issue Classification



- Elicitation will focus on passive system LOCAs.
- Relevant active system LOCAs will be added.
- Important piping and non-piping variables identified.
- Elicitation structure will support top down and bottom up analysis.

Piping Issue Classification

- Brainstormed variables in all relevant categories which influence the LOCA frequencies: materials, geometry, loading, mitigation & maintenance, degradation mechanisms.
- Agreed that variables and their effects are a function of the piping system.
- Individual categories developed for experts to summarize pool of applicable variables for a given piping system.
- Determined LOCA sensitive piping systems for BWR and PWR plants.
- Determined which of the individual variables in each of the five categories were relevant for each piping system considering individual plant variability.
- Developed master tables for BWR and PWR plants for the expert elicitation panel.

Non-Piping Issue Classification

- Identified approximately 25 different sections of primary components (i.e. pressurizer, reactor, steam generator, pumps, valves) where passive system failures could lead to a LOCA.
- Discussed failure mechanisms which could lead to LOCAs in these components.
- Identified components that may have existing failure data.
- Determined which of the individual variables in each of the five categories were relevant for each non-piping system.
- Developed master tables for non-piping LOCA contributors for the expert elicitation panel.

Formal Elicitation Approach

- Select panel and facilitation team.
- Develop technical issues.
  - Define scope and objectives of elicitation.
  - Construct approach for determining LOCA frequencies.
  - Determine significant issues affecting LOCA frequencies.
- **Quantify base case estimates.**
  - **Develop quantitative estimates for well-defined piping conditions.**
  - **Two estimates using PFM and two estimates from service history analysis.**
- Formulate elicitation questions.
- Conduct individual elicitations.
- Analyze quantitative results and qualitative rationale.
- Summarize and document results.

Piping Base Case Development

- The base cases will be used to anchor the elicitation responses.
- Base case conditions specify the piping system, piping size, material, loading, degradation mechanism(s), and mitigation procedures.
- Five Base Cases Defined.
  - BWR
    - Recirculation System
    - Feedwater System
  - PWR
    - Hot Leg
    - Surge Line
    - High Pressure Injection makeup.
- The LOCA frequency contribution (per year) of each set of base case conditions will be calculated as a function of leak rate and operating time.
- Four panel members chosen to perform calculations: two using operating experience and two using probabilistic fracture mechanics.

Piping Base Case Approach

- Iterative process involving facilitation team and expert panel.
- Evaluate LOCA frequencies at 25 (current), 40 (end-of-license), and 60 years (end-of-license extension) after plant startup.
- Each base case member should benchmark results using service experience for leaking cracks.
- All base case calculations should capture as closely as possible the conditions established by the expert panel.
- Sensitivity analyses of PFM results conducted to evaluate:
  - Seismic loading
  - Effect of ISI
  - Loading history variability
  - Effectiveness of mitigation

Non-Piping Base Case Development

- The non-piping base cases could have been developed in a similar manner to the piping base cases.
  - Choose several representative systems.
  - Examine and extrapolate operating experience through modeling
- However, the variety and complexity of the non-piping failure mechanisms makes this assessment intractable and of limited value.
- Philosophy here is to conduct database searches for each non-piping failure mechanism listed to develop leaking and cracked component frequencies.
- These frequencies will be used to anchor the non-piping responses for each expert.
- Each expert must determine how to translate the leaking and crack frequency information into meaningful LOCA estimates.

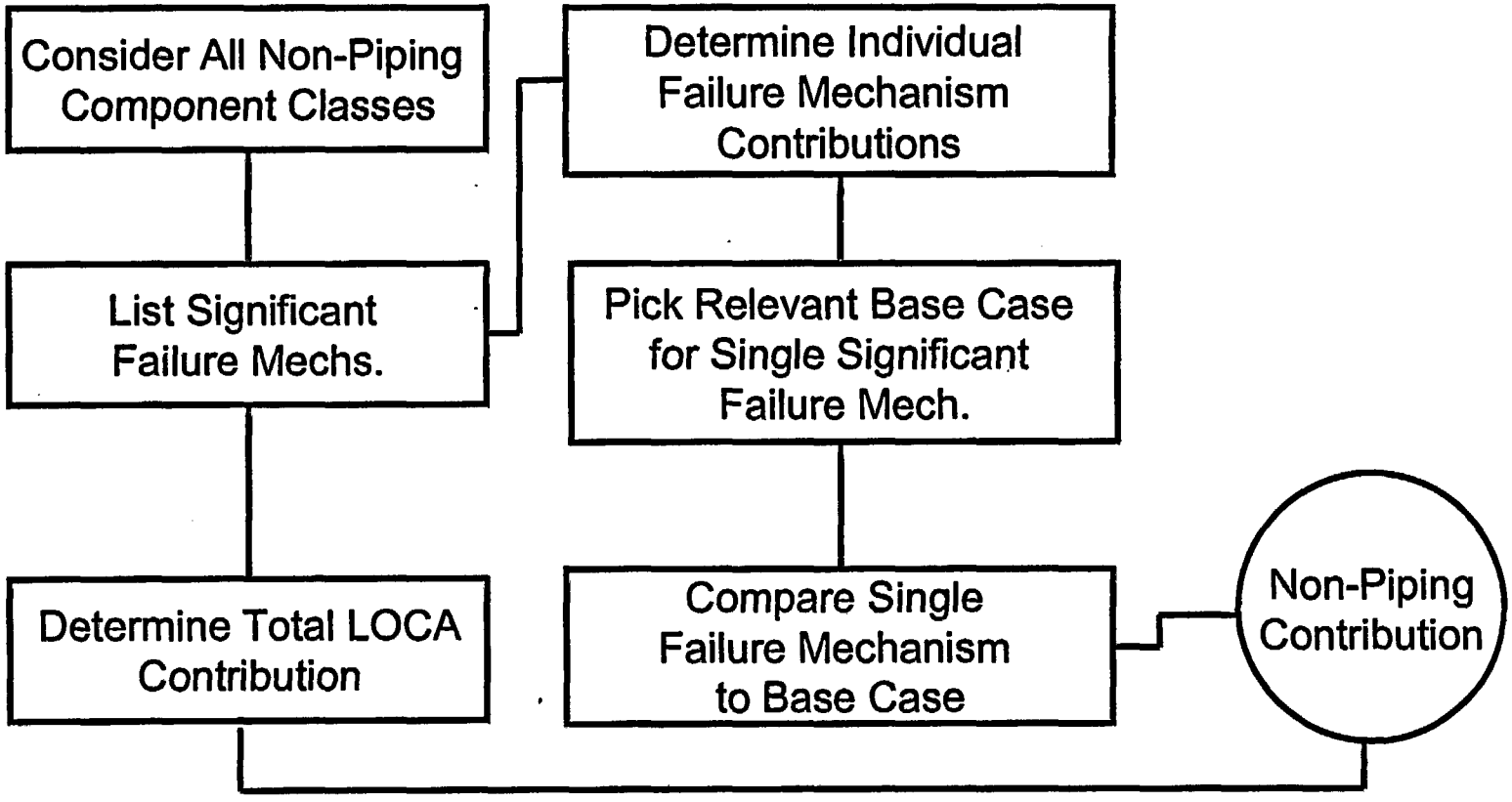
Formal Elicitation Approach

- Select panel and facilitation team.
- Develop technical issues.
  - Define scope and objectives of elicitation.
  - Construct approach for determining LOCA frequencies.
  - Determine significant issues affecting LOCA frequencies.
- Quantify base case estimates.
  - Develop quantitative estimates for well-defined piping conditions.
  - Two estimates using PFM and two estimates from service history analysis.
- **Formulate elicitation questions.**
- Conduct individual elicitations.
- Analyze quantitative results and qualitative rationale.
- Summarize and document results.

Elicitation Question Development

- Questions will be focused on the following topic areas.
  - Base Case Evaluation.
  - Regulatory and Utility Safety Culture.
  - LOCA frequencies of Piping Components.
  - LOCA frequencies of Non-Piping Components.
  - LOCA Frequencies of Piping Components under Emergency Faulted Loading Conditions.
  - LOCA Frequencies of Non-Piping Components under Emergency Faulted Loading Conditions.
- Questions will be asked relevant to a set of conditions and quantitatively linked to the base case results.
- Each question will ask for mid, low, and high values for each question as well as appropriate rationale or comments.
- Questions can be answered using a top-down or bottom-up approach.
- Rationale will be discussed for important and some unimportant issues for each expert.

Non-Piping Components: Top-Down Approach



Ongoing and Future Elicitation Work

- **Conduct individual elicitations.**
  - Provide answers to questions and rationale for answers.
  - Discuss significant issues which impact LOCA frequency estimation.
  - First two scheduled for July 15th and 16th. Remaining ten to be completed between mid-August and end of September.
- **Analyze quantitative results and qualitative rationale.**
  - Calculate results for each expert if appropriate.
  - Combine answers for individual questions and calculate results.
  - Propagate uncertainties.
- **Conduct wrap-up meeting.**
  - Summarize quantitative and qualitative results.
  - Summarize analysis methodology and LOCA results.
  - Obtain feedback from the expert panel.
- **Summarize and document results.**

SRM Guidance

- The staff should conduct a practical reconciliation of LOCA frequency distributions by the 1) expert use of service-data, 2) Probabilistic Fracture Mechanics (PFM) and 3) expert elicitation to converge the results.
- **Provide a comprehensive LOCA failure analysis and frequency estimation.**
- **Develop realistically conservative estimates, with appropriate margin for uncertainty.**
- **The staff should credit leak-before-break considerations only in conjunction with the establishment by a licensee of reliable and comprehensive means to detect primary system leaks of the relevant size.**
- Use a 10-year period for the estimation of LOCA frequency distributions, with re-estimation every 10 years and review of new type of failures every 5 years.

Addressing Specific SRM Guidance

- **"Provide a comprehensive LOCA failure analysis and frequency estimation."**
  - Include piping and non-piping LOCA contributions.
  - Consider LOCA contributions from all modes of operation.
  - Examine conditional LOCA probabilities under extreme loading conditions.
- **"Develop realistically conservative estimates, with appropriate margin for uncertainty."**
  - Develop best estimate values for all LOCA distributions.
  - Evaluate uncertainty among all experts as well as for each expert's responses. Combine answers for individual questions and calculate results.
  - Propagate uncertainties to understand impact and appropriateness of subsequent regulatory action.
- **"The staff should credit leak-before-break considerations ...".**
  - Credit leak detection based on technical specification limits when evaluating both the service history and in making future projections of operating performance
  - Identify and quantify LOCA contributions of non-leaking cracks.

SRM Guidance

- The staff should conduct a practical reconciliation of LOCA frequency distributions by the 1) expert use of service-data, 2) Probabilistic Fracture Mechanics (PFM) and 3) expert elicitation to converge the results.
- Provide a comprehensive LOCA failure analysis and frequency estimation.
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- The staff should credit leak-before-break considerations only in conjunction with the establishment by a licensee of reliable and comprehensive means to detect primary system leaks of the relevant size.
- **Use a 10-year period for the estimation of LOCA frequency distributions, with re-estimation every 10 years and review of new type of failures every 5 years.**

LOCA Frequency Reevaluation: Passive LOCA Code Development

- **Objectives:**
  - Determine the relationship between break size and expected event frequency for large primary system pipes (>150 mm diameter).
  - Provide confirmatory analysis of elicitation results.
  - Develop tool which can be used for subsequent frequency re-evaluation.
- **Approach**
  - Construct separate modules to consider piping, non-piping contributions, and future surprise mechanisms.
  - Modules will couple state-of-the-art PFM modeling with understanding of operating experience historical, recent, and potential degradation mechanisms to determine frequency partitioning.
  - Scale modeling frequencies using expert judgment to determine the LBLOCA frequency.
  - Use insights from elicitation to initially focus on the most important systems and mechanisms.
  - Monitor and interact with the NURBIM program which has similar objectives.

LOCA Frequency Reevaluation: Continuous Assessment of LOCA Challenges

- **Objectives:**
  - Develop framework for evaluating operating experience for LOCA precursor events in piping and non-piping components.
  - Evaluate mechanisms or trends which could be detrimental affect future LOCA frequencies.
- **Approach**
  - **Participate in the CSNI-sponsored OECD Piping Database Exchange (OPDE) project to expand international operating experience.**
    - Twelve participating countries: Belgium, Canada, Czech. Republic, France, Finland, Germany, Japan, Korea, Spain, Sweden, Switzerland, U.S.
    - The SKI-pipe SLAP database serves as the baseline.
    - Year 1 of 3 year effort is focusing on events between 1998 and 2001. Year 2 on events from 1995 – 1998 and 2002.
  - **Continue to evaluate international operating experience and research results to identify trends and mechanisms which warrant further research.**

ESBWR Pre-Application Review

Amy Cubbage, Project Manager
New Reactor Licensing Projects, NRR

ACRS
July 10, 2003

1

ESBWR Pre-Application Scope

- TRACG Application for ESBWR LOCA and Containment Analyses
- TRACG Qualification
- Test and Analysis Program Description (TAPD) and PIRT
- SBWR and ESBWR Testing Reports
- ESBWR Scaling Report

2

ESBWR Pre-Application Scope

- Product – Safety Evaluation Report on TRACG Application and Testing Program

3

ESBWR Design Certification Scope

- Design
- Transients
- ATWS
- Stability
- LOCA Events
- Severe Accidents
- PRA

4

Gilena Monroe - Bio

Miss Gilena Monroe joined the ACRS staff on June 16th as a summer intern. Currently, Gilena is a full-time Graduate student attending North Carolina A&T State University. She has a B.S. degree in Computer Science and is presently majoring in Industrial and Systems Engineering with a concentration in Human-Machine Systems/Human Factors. She is working with the ACRS as a Student Engineer on topics of Human Factors Engineering and Human Reliability.

G:Bio.Jain

Dr. Bhagwat P. Jain

Bio-Data

Dr. Jain will be joining the ACRS staff as a Senior Staff Engineer on July 14, 2003. He has been with the NRC for 5 years. During this period, he has served in NRR (Division of Engineering), NSIR, and RES (Division of Engineering Technology). Currently he is a project manager in RES. Prior to joining the NRC, Dr. Jain worked with Carolina Power & Light Company as a project engineer at the Brunswick nuclear power plant, AES Corporation as a supervising structural/mechanical engineer at the Prairie Island nuclear power plant, and with Sargent & Lundy Engineers, Chicago, as a supervising structural engineering specialist. He is a registered professional engineer with a Ph.D. in structural engineering which he received in 1976 from Illinois Institute of Technology, Chicago. In addition, Dr. Jain has experience in the evaluation of nuclear plant safety issues relating to plant structures, systems, and components of PWR and BWR containments. He is experienced in the structural design and licensing of several nuclear power plants (e.g., Lasalle, Zimmer, Byron, Braidwood). Dr. Jain has a broad range of over 25 years experience in progressively responsible positions in private nuclear power industry with design consultants and power utility companies, and the NRC.