ORIGINAL ACRST-3129

OFFICIAL TRANSCRIPT OF PROCEEDINGS
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

Title: ACRS MEETING - FIRE PROTECTION

PROCESS USING ADAMS
TEMPLATE: ACRS/ACNW-005

Docket No.:

Work Order No.: ASB-300-1518

LOCATION: Rockville, MD

DATE: Monday, October 16, 2000

PAGES: 1 - 351

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UNITED STATES NUCLEAR REGULATORY COMMISSION'S

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

October 16, 2000

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

1 UNITED STATES

2 NUCLEAR REGULATORY COMMISSION

3 ***

4 ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

5 ***

6 SUBCOMMITTEE ON FIRE PROTECTION

7 ***

8

9 Room T2-B3

10 Building 2

11 White Flint North

12 11545 Rockville Pike

13 Rockville, Maryland

14

15 Monday, October 16, 2000

16

17 The subcommittee met, pursuant to notice, at 8:30

18 a.m.

19

20

21

22

23

24

25

1 MEMBERS PRESENT:
2 John D. Sieber, Chairman
3 Dana A. Powers, ACRS Chairman
4 George E. Apostolakis, ACRS Vice Chairman
5
6 ALSO PRESENT:
7 Amarjit Singh, ACRS Staff
8 Michael T. Markley, ACRS Staff
9 John T. Larkins, Executive Director, ACRS
10 Tom Gorman, BWR Owners Group
11 Fred Emerson, Nuclear Energy Institute
12 George Stramback, BWR Owners Group
13 Alan Ettlinger, BWR Owners Group
14 Leon Whitney, Office of Nuclear Reactor Regulation, NRC
15 Nathan Siu, Office of Research, NRC
16 Eric Weiss, Office of Nuclear Reactor Regulation, NRC
17 Bijan Najafi, EPRI, SAIC
18 Dennis Henneke, Southern California Edison
19 Steve Nowlen, Sandia National Laboratory
20 Mark Cunningham, Office of Research, NRC
21 Rich Bielen, National Fire Protection Agency
22 Denis Shumaker, PSEG Nuclear
23 Cliff Sinopoli, PECO Energy
24 Andy Robosky, Southern California Edison
25

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

2 [8:30 a.m.]

3 MR. SIEBER: Good morning. The meeting will now
4 come to order. This is a meeting of the ACRS Subcommittee
5 on Fire Protection.

6 I am Jack Sieber, Chairman of the Subcommittee on
7 Fire Protection. Other ACRS members in attendance today are
8 Drs. Dana Powers and George Apostolakis.

9 The purpose of this meeting is to review the
10 revised draft NFPA-805 performance standard for the fire
11 protection for light water reactor electric generating
12 plants; the draft regulatory guide on fire protection for
13 operating nuclear power plants; post-fire safe shutdown
14 circuit analysis, and other fire protection-related issues.

15 Mr. Amarjit Singh is the cognizant ACRS staff
16 engineer and designated Federal official for this meeting.

17 The rules for participation in today's meeting
18 have been announced as part of the notice of this meeting
19 previously published in the Federal Register on October 2,
20 2000.

21 A transcript of the meeting is being kept and will
22 be made available as stated in the Federal Register notice.
23 It is requested that speakers first identify themselves,
24 speak into the microphone, and speak with sufficient clarity
25 and volume so that they may be readily heard.

We have received no written comments, but we have received a request to make an oral statement from a representative of EPM.

We will now proceed with the meeting and I will call upon Mr. Tom Gorman, of the BWR Owners Group, to begin.

MR. GORMAN: Good morning. My name is Tom Gorman. I'm an employee of PP&L Corporation, and I'm also a member of the Boiling Water Reactors Owners Group, the Appendix R -- is this one? I'll try to keep it loud.

I'm going to talk about four specific topics here today. I'm going to give you a little bit of background on what the industry has been doing from the BWR Owners Group perspective relative to the circuit analysis issues. I also want to talk a little bit about fire protection defense-in-depth and then I want to go through the two primary issues that we have been interfacing with the NRC staff on, and that's the use of the SRV and the lower pressure systems a post-fire safe shutdown methodology, and then the guidance document that the BWR Owners Group has provided for post-fire safe shutdown.

The BWR Owners Group formed the Appendix R Committee in the summer of 1997 and our objective was to provide an understandable and effectively sound design criteria for performing post-fire safe shutdown analysis.

We did this in response to some issues that were

1 coming up during NRC inspections of individual licensees and
2 we felt that it was paramount that we establish a firm
3 design and a firm licensing basis for the design of these
4 facilities.
5 We thought if we did that, that would be a useful
6 tool for not only the individuals who perform those types of
7 analysis within the utility organizations, but we also
8 thought it would be useful to provide a clear and auditable
9 document for inspections, both internal to the utilities and
10 from outside organizations.
11 And from a priority perspective, this was
12 identified as the number one priority for the Boiling Water
13 Reactors Owners Group, in a letter to Commissioner Diaz in
14 November of '98.
15 As we got together, the issues that we identified
16 were three. Really, the first was that we believe the use
17 of SRVs and low pressure systems was an acceptable way to
18 shut down a power plant in response to a fire.
19 There were some issues floating around relative to
20 circuit analysis assumptions that were used in the post-fire
21 safe shutdown analysis, and I guess the third issue that we
22 identified was the fact that we really didn't have a
23 criteria document that established what the rules and
24 requirements were relative to these types of analyses and we
25 viewed that, as a whole, to have potential to generate

1 future issues and we wanted to kind of head things off at
2 the pass by putting together that document and trying to
3 nail down all of the issues in one effort.
4 Now, there have been a number of efforts that have
5 been going on. NEI has been developing a risk-based
6 document. The Owners Group has been developing a
7 deterministic document that really is aimed at identifying
8 what we current do, what's required by the regulation and
9 what we believe is an acceptable and a safe way to perform a
10 post-fire safe shutdown analysis and then, in the long term,
11 the NFPA-805 standard was looking at developing a
12 risk-informed and a performance-based approach.
13 Essentially, the plan, at its inception, was that
14 these three documents would feed each other and, in feeding
15 each other, would provide a basis for the subsequent
16 documents.
17 So if there were issues in the BWR Owners Group
18 document that needed some risk information to resolve, we
19 would rely on the NEI effort and then the culmination of the
20 deterministic information and the NEI information would be
21 inputs into the 805 standard.
22 Now, there's been a lot of people that have been
23 spending a lot of time on these efforts, both within the NRC
24 and within the industry. A number of people have been
25 participating on two and I think even three of these task

1 forces and we spent a couple years at it and I think we're
2 at the point now where we have some products that we're able
3 to talk about.
4 Shifting gears a little bit, going into fire
5 protection defense-in-depth, this is the cornerstone program
6 for protection of our power plants from fires.
7 This program relies on trained and qualified
8 personnel in the power plant, relies on comprehensive
9 procedures and plant design features that prevent fires from
10 starting and mitigate their effects.
11 With respect to the trained and qualified
12 personnel, we all have site fire protection engineers that
13 are responsible for those programs, on-site fire brigades
14 that are trained to respond to those events. People from
15 operations staff participate on those on-site fire brigades,
16 and we have post-fire safe shutdown analysis engineers who
17 have researched the component and cable locations for the
18 critical systems in the power plant and have taken actions
19 to make sure that we have an available path for shutdown.
20 They consist of systems engineers, electrical
21 engineers, and then the fire barriers engineers that
22 separate the redundant trains and also provide protection
23 for the trains.
24 With respect to the procedures, we have procedures
25 in place, limitations on the amount of in situ combustibles

1 that can be installed into the power plant. We also have
2 strict controls over where transient combustible materials
3 can be used.
4 If there are any activities going on in the power
5 plant where ignition sources might be in use, there are
6 procedures that control those that require use of fire
7 watches.
8 DR. POWERS: Let me ask you a question. You
9 indicate strict control of transient combustibles. What you
10 mean is that there are rules against having excessive
11 amounts of transient combustibles.
12 MR. GORMAN: Yes.
13 DR. POWERS: Do they ever get violated?
14 MR. GORMAN: Occasionally, I think you'll find
15 instances where those are violated, yes.
16 DR. POWERS: I mean, what's the impact of that?
17 Your controls are ineffective.
18 MR. GORMAN: Well, the controls are comprised of
19 procedures that require permitting for the materials that
20 are installed in the plants and then periodic walk-throughs
21 of the plants that look for things that are -- things that
22 slip through in the procedural world. So one of those two
23 mechanisms is usually the mechanism that captures it.
24 DR. POWERS: What I'm trying to understand is -- I
25 mean, it says it's a strict control, but it obviously isn't

1 too strict, if it gets violated.

2 What significance should I attach to this strict

3 control of combustibles?

4 MR. GORMAN: I would say you need to look at that

5 in terms of people are told what they can bring into the

6 power plant. There are people that review what is allowed

7 into the power plant in terms of combustibles and that any

8 activities that are going on in the power plant where

9 combustible materials are involved are overviewed by people

10 that understand the significance of those relative to power

11 plant functions, power plant equipment, which might be a

12 little bit different than what you might have in an

13 industrial facility where those types of controls are not in

14 place.

15 DR. POWERS: I'm struggling to identify, right off

16 the top of my head, an industrial facility that doesn't have

17 some control over its combustibles.

18 MR. GORMAN: I would say our nuclear plant

19 controls are more restrictive, say, than the fossil plant

20 controls.

21 DR. POWERS: Similarly, you have inspection of

22 passive fire protection features. Do they ever fail the

23 inspection?

24 MR. GORMAN: Yes. And part of the inspection

25 criteria is to identify areas where these fire barriers may

1 have been degraded and to take those corrective actions. So
2 the positive point here is that those things are inspected
3 and then corrective actions are taken to bring them back to
4 their required status.
5 DR. POWERS: If we looked at the corrective action
6 programs for a cross-section of BWRs, representative, would
7 we find the age of corrective actions associated with fire
8 protection features about the same as everything else, a
9 little older, a little more attention given to them? Where
10 would they stand?
11 MR. GORMAN: I don't have an industry perspective
12 on that particular question.
13 DR. POWERS: Do you have any idea where I could
14 get that?
15 MR. GORMAN: I don't even have an answer on where
16 you could get that, Dana.
17 DR. POWERS: At least in the plants that I have
18 visited, I find that the corrective action programs, fire
19 protection features somehow seem to have an endurance that,
20 on the list of corrective actions, longer than most.
21 MR. GORMAN: Well, I can speak for the condition
22 at Susquehanna. One of the things that we've just done at
23 Susquehanna is we've just finished, within the last year, a
24 complete upgrade of our raceway fire barriers to Thermo-Lag
25 fire barrier issues.

1 DR. POWERS: As you know, the committee visited
2 Susquehanna and --
3 MR. GORMAN: And I was fortunate enough to be able
4 to talk with you.
5 DR. POWERS: Right. I don't know if fortunate was
6 the word for it, but we enjoyed the talk.
7 MR. GORMAN: Yes. I enjoyed the opportunity. So
8 that was a major upgrade to those raceway fire barriers.
9 During the process of going through the 9,000 lineal feet of
10 raceway that we upgraded, we found very limited instances
11 where the material was not as it was originally installed.
12 Many of these fire barriers are in locations where
13 they're very difficult to get to. They're not real
14 accessible from the perspective of people doing work that
15 might be bumping into them.
16 The bulk of the fire area boundaries that separate
17 the redundant trains are reinforced concrete structures and
18 the types of deficiencies that may be identified in those
19 during these passive inspections would be imperfections in
20 penetration seals where you'd have a nine to 12-inch
21 silicone foam seal and you may find that there's some
22 surface cracking on those.
23 You may find occasionally that one has been opened
24 up and it hasn't been properly repaired. But I think, in
25 general, the material condition of the plant remains good

1 and this is a program that helps maintain that.

2 We also have requirements for testing of the

3 active fire protection features, the sprinklers, the

4 detectors, the hose reels, extinguishers. We have training

5 for the fire brigade and we also have the required training

6 for our engineering personnel.

7 With respect to the plant design features,

8 extensive use of fire detection systems, we have fire

9 protection systems which are automatic or manual. The

10 manual systems would be fire extinguishers and your hose

11 reel stations. In some cases, control room, for example,

12 there would be a manual spare C02 system that would be

13 employed.

14 We have fire barriers that separate the fire areas

15 and in the reactor building areas, those are generally large

16 reinforced concrete structures. We have the fire barriers

17 to protect the redundant safe shutdown trains. We try to

18 use low combustible, low flammability materials in the

19 materials we install into the plant and we've also got

20 emergency lighting and communication systems that would

21 facilitate safely shutting down the plant in the event of a

22 fire.

23 MR. SIEBER: Do you periodically conduct fire

24 drills?

25 MR. GORMAN: Yes.

1 MR. SIEBER: Do you use off-site fire-fighting
2 folks?
3 MR. GORMAN: We have off-site fire-fighting
4 backup. I'm not sure to what extent those individuals
5 participate in the drills. I can get that information and
6 get that back to you, if you'd like.
7 MR. SIEBER: Okay. Plants I'm familiar with have
8 off-site fire people participate in drills, but one of the
9 issues that comes up from time to time at one plant or
10 another is the fact that the power plant hydrants, the
11 fittings are often different than the fittings than are on
12 city hydrants.
13 So the fire truck comes and can't hook up to the
14 plants' fire hydrants. Have you ever heard of that?
15 MR. GORMAN: I've heard of that. I think most of
16 us are beyond those types of issues. Cliff, were you going
17 to --
18 MR. SINOPOLI: Yes. My name is Cliff Sinopoli.
19 I'm at Peach Bottom Power Plant. I'm the On-Site Fire
20 Protection Engineer there.
21 As a rule, throughout the industry, typically,
22 once a year, we do have some sort of drill or at least
23 training session with the off-site fire departments, and I
24 can't say every plant does that, but that's pretty much the
25 standard throughout the industry.

1 At that time, we would test out things; for example,
2 compatibility of threads, making sure that our, for example,
3 pre-plans are consistent with how they would perform their
4 fire-fighting activities.
5 For example, our plant recently just did our
6 personnel accountability tags in a format similar to the
7 off-site fire department.
8 So I'd say, as a general rule, throughout the
9 industry, it's about once a year we get together with the
10 off-site fire departments.
11 MR. SIEBER: Thank you.
12 MR. GORMAN: So all of those components that I
13 just talked about add up to our defense-in-depth program,
14 and that program is really aimed at preventing fires from
15 starting, rapidly detecting and suppressing any fires that
16 do start, and providing passive fire features to prevent the
17 spread of fire.
18 And really the intent of that program is that we
19 don't want to damage plant equipment with a fire. So we
20 don't want to damage any of the plant equipment. We really
21 don't want to have fires in the plant.
22 It's difficult to 100 percent prevent a fire from
23 starting, but the goal is let's not damage any of the plant
24 equipment.
25 On top of that, we also provide a hard and safe

1 shutdown path that we protect to be available in the event
2 of a single fire in any plant area.
3 And when we demonstrate this safe shutdown
4 capability, we go off and we identify the systems that are
5 necessary in order to complete the safe shutdown functions
6 or activity control, pressure control, inventory control,
7 decay heat removal, and any support functions necessary for
8 those systems and some process monitoring.
9 We identify those systems. We identify the
10 required safe shutdown equipment that is necessary to make
11 those systems function. We identify all the cabling that's
12 necessary to have those pieces of equipment work. We
13 identify the physical location of that equipment in the
14 plant and at this point, the physical location is generally
15 on a room basis.
16 So people will know, for this selected set of
17 equipment, which particular room in the power plant the
18 raceway containing the circuits is located.
19 In order to identify the specific location with a
20 room where the circuits are located, there are raceway
21 layout drawings that are an aid in doing that, but generally
22 a plant walk-down is necessary in order to spot them
23 specifically.
24 And then with all that information, we assure that
25 we have one safe shutdown path, with the capability to

1 achieve and maintain safe shutdown in the event of a fire.
2 We make sure that's available for each fire area.
3 Now, with respect to the current program, there
4 are a number of conservatisms that are included in there.
5 We do have very large fire areas, and I have some
6 supplemental slides here that I'll just use to depict that.
7 We make the assumption that unprotected equipment
8 and cables within the fire area are assumed to be damaged.
9 So we have a large fire area and if you're in that fire area
10 and you're not protected, we just assume you're not going to
11 be capable of performing your function.
12 Any unexamined equipment and cables are not
13 credited for mitigating the effects of the fire. What I
14 mean by that is if we haven't taken the equipment through
15 those steps that I discussed on the previous slide and we
16 don't know all of the cable to component relationships, we
17 don't know exactly all the functional relationships and the
18 locations of those circuits, then we just assume that that
19 information -- or that equipment is not available to perform
20 its function.
21 And we assume that that equipment is damaged
22 unless, in being damaged, it provides a benefit to us.
23 So for example, on the unexamined equipment,
24 taking, again, Susquehanna, because that's what I know,
25 we've got about 2,000 pieces of equipment on the safe

1 shutdown list. We've got about 25,000 components in the
2 power plant that perform functions for the power plant.
3 So right off the bat, we're assuming that
4 essentially 90 percent of the equipment that we have in the
5 plant, when we perform this post-fire safe shutdown
6 analysis, is not available to function for us.
7 With respect to cables, I'd say we probably have
8 seven to 10,000 cables that we include as safe shutdown
9 cables associated with those 2,000 components, and that's
10 out of a total population of about 50,000 cables.
11 DR. APOSTOLAKIS: You didn't explain the last
12 bullet.
13 MR. GORMAN: Okay. With respect to equipment --
14 let me put that back up so everybody can see it. Equipment
15 damage is assumed unless it provides a benefit. I guess the
16 most readily used example of that would be if you had a
17 fire-induced loss of off-site power and it affected, say,
18 your ventilation systems, you would not assume that your
19 normal lighting was unavailable because that normal lighting
20 provides a significant heat load to the areas of the plant
21 that would test the temperature rises in the individual
22 rooms.
23 So we would assume that somehow the lights are
24 available, the lights stay on, the lights provide a heat
25 load and we would assess whether or not that was an impact

1 to us based on those types of assumptions, rather than
2 assuming that all the lighting was lost and the heat loads
3 that would affect HVAC temperatures were not available.
4 DR. APOSTOLAKIS: So what is the benefit in this
5 case?
6 MR. GORMAN: Well, it's not a benefit. It's just
7 a conservatism.
8 DR. APOSTOLAKIS: So you would assume that the
9 lights stayed on.
10 MR. GORMAN: If the lights stay on, then the
11 lights would heat the rooms up more. If they heated the
12 rooms up more, the you may either need to provide more HVAC
13 equipment as a part of your required safe shutdown equipment
14 than what you would normally require, or you may require
15 more actions by people in order to mitigate the temperature
16 rises by putting in localized fans to move air, opening
17 doors to get mixing between compartments and things along
18 those lines.
19 Maybe that's not the best example.
20 MR. STRAMBACK: Tom, maybe the example of off-site
21 power, when it's available or not, might be a stronger
22 example.
23 MR. GORMAN: Yes. There is an option to use
24 off-site power versus using the on-site emergency diesel
25 generators and a number of utilities would make the

1 assumption that off-site power is lost and we are forced to
2 use the on-site emergency diesel generator capability.
3 When you lose that off-site power capability, that would
4 knock out all of your balance of plant equipment that would
5 be available for providing heat removal, so the condenser,
6 providing makeups for your feed water and your condensate
7 systems.
8 This is just a site plan of the Susquehanna
9 station. Essentially, the bolded areas are the areas that,
10 for us, are the areas that have the safe shutdown equipment
11 circuits, cabling and things like that located within them,
12 emergency service water pump valves which provides water
13 from our spray pond, that's the ultimate heat sink; diesel
14 generator buildings; reactor building two, reactor building
15 one, and then a control structure.
16 So if you take a blowup of the general areas of
17 concern, we've got a control structure, a Unit 2 and a Unit
18 1 reactor building, and four diesel generators, and the next
19 slide I'm going to put up is kind of a section that's an
20 elevation through those two reactor buildings.
21 DR. APOSTOLAKIS: We don't have those, do we?
22 MR. GORMAN: No.
23 MR. SINGH: Tom, can we have that afterwards?
24 MR. GORMAN: Sure.
25 MR. SINGH: Thank you.

1 MR. GORMAN: Now, when you look through those two
2 reactor buildings, again, here is your Unit 1 reactor
3 building, Unit 2 reactor building, these heavy lines are the
4 lines that indicate the fire area boundaries.
5 The smaller boxes are fire zones generally on the
6 order of large room sizes. The fire zone is within one fire
7 area, so this would be a fire area, all of these zones would
8 assume to be subjected to the same fire.
9 So, for example, this -- I know you can't read
10 this, but you have to trust me on this one, this is
11 elevation 645 in the basement of the reactor building.
12 DR. POWERS: It's not a big stretch to trust you
13 on that one.
14 MR. GORMAN: This is elevation 779, this is the
15 refueling floor. So from 645 up to 749 would be one fire
16 area. Similarly, over here, that would be one fire area.
17 So the basic assumption in this post-fire safe shutdown
18 analysis is that if we have a fire in here, anything within
19 those bounds could be affected by the fire. Anything that
20 is unexamined in the power plant is already lost, so we
21 threw 90 percent of the equipment away, and then we assumed
22 that if a fire -- a fire down here can damage a fire up
23 here.
24 Now, there is a provision that is sometimes used
25 in the analysis for doing either an exemption or a deviation

1 or an engineering evaluation which is sometimes used to
2 demonstrate that we really don't believe that a fire here
3 can go through this one-foot-nine-inch thick concrete slab,
4 bypass the suppression and detection over here, and end up
5 over here damaging a piece of equipment.
6 So there are some arguments that are used on
7 separation within people's analysis. But in general, the
8 analysis assumption is that the fire extends throughout
9 those areas.
10 DR. POWERS: If we examined industrial data for
11 facilities of roughly similar design, would we come away
12 saying that this was a particularly conservative assumption?
13 MR. GORMAN: I think you would. Most of what is
14 out in these areas in the reactor buildings are -- there is
15 a fair number of cable and cable trays.
16 In our plant, we have Thermo-Lag materials, which
17 are combustible themselves, but there are massive concrete
18 structures. There's a lot of large structural steel.
19 There's a lot of equipment and all of that equipment has a
20 heat sink effect on any kind of a heat buildup in those
21 areas, and, again, when we look at control of the
22 combustibles, both respect to what we're allowed to place in
23 these areas, plus what we allow people to come in, when we
24 look at the provisions we make for if you're doing anything
25 out there with the potential to create an ignition source,

1 we have fire watches posted to make sure that things don't
2 go awry.
3 I think you would conclude that it was
4 conservative.
5 DR. APOSTOLAKIS: So where is the reactor in this
6 picture?
7 MR. GORMAN: Well, you don't get it in this one,
8 George. It's either out here half a reactor building or
9 back into the -- typically --
10 DR. POWERS: When you look at these fire areas,
11 you look at them individually; that is, you don't assume
12 anything crosses the boundaries, the dark line boundaries
13 that you've draw in there.
14 MR. GORMAN: That's correct.
15 DR. POWERS: That represents -- that non-crossing
16 assumption is based on the probability being very low that
17 the fire would cross a boundary. Do you have any feel for
18 what that probability has to be to make that assumption?
19 MR. GORMAN: Not really, no. I think it's a
20 pretty low number. I don't know what kind of a --
21 typically, a number of ten-to-the-minus-six,
22 ten-to-the-minus-seven is a number people have used. I
23 would think it's much lower than that.
24 DR. POWERS: What I'm asking really is at what
25 point would I make that assumption that you don't cross the

1 fire boundary. It would seem to me that if it was one in a
2 thousand, I would be very happy making that assumption that
3 it didn't cross the fire boundary.
4 MR. GORMAN: The reason why we have fire zones
5 that are conglomerated in the fire areas is that in order
6 for us to call a fire area, a boundary a fire area boundary,
7 most cases, we had to put some kind of pedigree on the
8 majority of the components in there.
9 So if you took a normal reinforced concrete wall,
10 two-foot thick, it might have a door in it, the door in a
11 fire zone boundary may not be a fire rated door. It's
12 possible that it's equivalent to a fire rated door, because
13 it may have been brought to the same specification, but it's
14 not rated, it's not labeled.
15 There may be some penetrations through those
16 barriers that are there to allow conduits to pass from one
17 area to the other, where you might have a 12-inch diameter
18 opening with a four-inch diameter conduit going through the
19 middle of the wall, and it may not have fire barrier sealing
20 material in that penetration annulus.
21 There may be a fire -- a duct going through those
22 barriers that doesn't have a fire damper included in them.
23 So those are the types of differences between a fire zone
24 boundary and a fire area boundary.
25 A fire boundary area, all those types of things

1 need to be at least looked at and justified.

2 DR. POWERS: The question is, you've got those

3 protections at your fire boundary, but sometimes they fail.

4 Sometimes people leave doors open.

5 And at what point do you begin to question that

6 assumption of non-crossing? I don't think it has to be as

7 low as ten-to-the-minus-six. It seems to me one in a

8 thousand would make me very happy, probability. How often

9 do you have a big fire?

10 MR. GORMAN: Right.

11 DR. POWERS: I mean, it's conditional

12 probabilities here.

13 MR. GORMAN: It's conditional, right.

14 DR. POWERS: And ten-to-the-minus-six maybe

15 overall including the probability of a fire, but for the

16 boundary itself, I would think even one in a hundred

17 wouldn't cause me a great heart attack.

18 MR. GORMAN: Generally, the barriers are pretty

19 good. There is a lot of attention on -- the fire area

20 boundaries are surveilled every 24 hours by people in the

21 operations staff to make sure that doors are closed.

22 But to get back to George's question, these two

23 circles are the containments. I don't remember exactly

24 where we took that section. It may have been up at this

25 point, looking west. And then these walls here represent

1 the circle that I just showed you on that past scheme, and
2 then the reactor is here in the center.
3 So the containment, in a number of BWRs, kind of
4 is in the center of the reactor building and it does
5 function to have a physical separation between one or the
6 other side and generally people have tried to separate their
7 divisions on one side or the other of that.
8 But the more we look at the cables, the more we find out
9 that even when you separate the divisions, you almost always
10 run into instances where cabling has to cross through areas
11 where it doesn't belong, and that's where we generally get
12 into the circuit analysis issues and discussions.
13 So if I can just finish up, again, with this one.
14 The large fire areas and the assumption of damage throughout
15 the fire area, unless there is a specific evaluation that
16 justifies why a fire is not going to go to a particular
17 location.
18 And depending on your licensing basis, that may or
19 may not need to be reviewed and accepted by the staff.
20 I want to shift again now, moving to the third
21 build-out, which was the use of the SRVs and the lower
22 pressure systems. Again, we're coming at this from the
23 perspective of we tried to put a fire protection program in
24 place that will prevent fires from starting, that will
25 prevent damage to plant equipment and, in addition to that,

1 we want to make sure that we have identified a hard and safe
2 shutdown path that would be available in the event of a fire
3 to take us to safe shutdown.
4 That's not to say that that is the path that is
5 the path that will be used, but that is the path that is
6 hardened if a fire beyond our wildest imaginations were to
7 occur.
8 Our position on this issue is that using our SRVs
9 and using our low pressure systems is an acceptable
10 methodology for a redundant or an alternative shutdown in
11 accordance with the current requirements.
12 Typically, redundant safe shutdown is a term that
13 the industry has used to apply to shutdown when the operator
14 remains in the control room and he is using plant controls
15 from the control room.
16 If there are areas where one of the two redundant
17 trains cannot be protected, then we go to an alternate
18 shutdown path and, typically, for the industry, that would
19 be an area like the control room or the cable spreading
20 room, for some plants, and for those conditions, people
21 would go to a remote shutdown panel in order to safely shut
22 down their plant.
23 Now, we consider that what we've been asking for
24 is really not -- we haven't been looking at it as a change.
25 It's something that we believed we had been allowed to do

1 all along that had been endorsed and had been accepted. We
2 got into a difference of opinion relative to that and
3 because of that, we have been going through this effort to
4 kind of firm up a position and to answer the questions that
5 the staff has been posing to us relative to this issue.
6 DR. POWERS: You see the use of the SRVs and low
7 pressure systems as distinguished from use of the ADS and
8 the low pressure systems.
9 MR. GORMAN: I think it could be either, but
10 typically in the post-fire safe shutdown analysis, the
11 automatic functions are not protected functions. All the
12 actions that the operator takes would be manual start of
13 systems.
14 Depending on the plant design, you have the
15 ability to open individual SRVs. You also may have an SRV
16 function or an ADS function where you can open four, five or
17 six all at one time, if that were necessary.
18 DR. POWERS: I guess what I'm fishing for is
19 suppose the hypothetical that the Commission said no, you
20 can't do this, you can't use this as the alternate safe
21 shutdown to meet the requirements of 10 CFR Appendix R,
22 whether you've been allowed to or not.
23 What would be your choice after this?
24 MR. GORMAN: If you get to that point, then I
25 think you really -- a lot of people would be forced to go

1 back and to protect the high pressure shutdown methodology.

2 DR. POWERS: Okay.

3 MR. GORMAN: I believe the staff has, in the past,

4 taken a position on the use of alternative shutdown using

5 these systems as being acceptable and most of the discussion

6 we've been having relative to this current issue is on can

7 it be used as a redundant shutdown method.

8 One of our concerns with -- I guess one of the

9 initial options that was proposed was let's just call it an

10 alternative shutdown path and when we read the regulations,

11 an alternative shutdown path needs to be independent of the

12 fire area where the fire is occurring, and in the majority

13 of the cases where we've used these systems for redundant

14 shutdown, they are not independent.

15 They are out there in the zone, in the area, in

16 the reactor building, and they were protected because they

17 presented the least impact to the shutdown systems. So

18 they're not independent.

19 So we're thinking if we can't call them -- if

20 we're not allowed to call them redundant, we don't believe,

21 from our side, that we can call them alternative and if you

22 can't call them one of the two of those, then you've got to

23 go get something that you can count on.

24 Again, with respect to this shutdown methodology,

25 we view it as a hardened shutdown methodology. It's got

1 special protection features for it. It's got special
2 information and procedures relative to impacts to it. But
3 our expectation is that if the plant is required to shut
4 down in response to a fire, that operators will use whatever
5 is available.
6 Our expectation is also that the defense-in-depth program
7 really needs to minimize challenges to plant equipment and
8 if we're at the point where we are damaging plant equipment,
9 then our defense-in-depth programs need some serious
10 re-looking.
11 So this is designed to prevent us from damaging
12 equipment. If any does get damaged, we do not expect that
13 it would all be damaged up to the point of only having the
14 hardened system available. We would expect the plant
15 operator to respond and to use whatever is available.
16 And if the operator, in responding to a fire, is
17 required to enter his emergency operating procedures, then
18 we would expect him to enter those emergency operating
19 procedures.
20 Those procedures are symptom-based. Those
21 procedures will instruct him to use whatever is available
22 and if things aren't available, those procedures will tell
23 him what to do next.
24 And in those emergency operating procedures, if
25 you get to the point where everything does progress to the

1 point where nothing else is available, you usually end up
2 down at your SRVs and your low pressure systems.
3 So, again, that's the protected hardened path.
4 Use everything that's available. We don't expect to get to
5 the point where we're damaging plant equipment. We expect
6 the operator to follow his procedures.
7 These systems are included in as a part of his
8 procedures and we expect them to be available if things ever
9 got to that point.
10 The approach that we used in order to come up with
11 our position paper was when we looked at all the regulations
12 and all the guidance, we wanted to make sure we weren't
13 doing anything that was in violation of the requirements.
14 We made sure that what we were doing didn't
15 present an unsafe condition for the core, the reactor or the
16 containment, and that was something that we felt pretty
17 sure, going into that evaluation, that it wasn't going to be
18 a problem, because these are systems that are designed for
19 shutting down our power plants.
20 And we did a qualitative examination of the
21 relative risk between shutting down with a high pressure
22 system versus shutting down with a low pressure system, and
23 we concluded that that was essentially a wash, from our
24 perspective.
25 So our conclusion relative to this shutdown

1 methodology is that it's an acceptable shutdown methodology
2 based on the design of the GE boiling water reactor. It's a
3 technically acceptable means of shutdown, it's a safe means
4 of shutting down. It's consistent with our current
5 procedures and our current operator training.
6 It satisfies our safe shutdown goal of protecting
7 the core, the reactor and the containment, and it can
8 accomplish all the required safe shutdown functions.
9 So that concludes our thoughts on SRVs and low
10 pressure systems and if there's no additional questions on
11 those, we can move into our post-fire safe shutdown guidance
12 document, which deals with circuit analysis issues.
13 DR. APOSTOLAKIS: How was this issue raised? Why
14 now? Why are we doing this now?
15 MR. GORMAN: It came up in inspections, in most
16 cases; I think in all cases, yes.
17 DR. APOSTOLAKIS: Like?
18 MR. SINGH: Jit Singh. This issue was raised back
19 when they did the FPFI inspection. That's the reason it was
20 raised.
21 DR. APOSTOLAKIS: When was this?
22 MR. SINGH: This issue has been on since almost
23 five years now and staff also discussed this issue with us
24 when they did the FPFI inspections two years ago.
25 MR. GORMAN: I think there were a number of plants

1 that had open inspection items relative to using SRVs and
2 low pressure systems as a redundant shutdown methodology and
3 then there were a number of issues that were raised during
4 fire protection functional inspections and other type
5 inspections relative to the use of this system.
6 DR. APOSTOLAKIS: I guess since Appendix R has
7 been on the books for considerably longer time, that's why
8 I'm a little bit puzzled. Why didn't we see this before?
9 MR. SINGH: We have.
10 DR. APOSTOLAKIS: When?
11 MR. SINGH: It was discussed when the staff
12 discussed the results of the --
13 DR. APOSTOLAKIS: No, no, I don't mean this
14 committee. I mean, this seems to be an Appendix R issue.
15 MR. ETTLINGER: My name is Alan Ettlinger. I'm
16 Manager of Fire Protection with New York Power Authority.
17 I'm a member of the Owners Group.
18 The issue was raised in the '97 timeframe, during
19 an inspection at Sharon-Harris. At that time, in order to
20 declare this, we would have required or, rather,
21 Sharon-Harris would have required suppression of detection
22 in the areas where they would have used low pressure
23 systems.
24 I believe that the modifications would have been
25 in excess of a million dollars or so and Sharon-Harris at

1 that time raised the issue and, therefore, the Owners Group
2 decided to address it.
3 DR. APOSTOLAKIS: I guess I'm a little bit
4 confused by the statement earlier on that you are not
5 requesting a change, but an endorsement for something that
6 you've been doing for a long time.
7 MR. ETTLINGER: I believe we've -- in going
8 through the licensing history with the staff, low pressure
9 systems, for the first ten years or so, was accepted as part
10 of standard SERs, standard fire protection SERs.
11 There appeared to be a change. There appeared to
12 be a position now by the staff that this is now required, to
13 require exemptions, to require to be ultimate shutdown.
14 So this is -- I think if you go through the
15 licensing history, in the early '80s, low pressure systems
16 were part of the standard fire protection Appendix R SERs.
17 Tom, is that correct?
18 MR. GORMAN: Yes, I think that's correct, Alan. I
19 think if you go back to the current issue slide that we have
20 right now, these are two issues that have visibility on it.
21 We considered this issue to be an issue because many of our
22 experiences with fire protection is that because the rules
23 and the requirements and the approach was not clearly
24 written down and defined, that as time went on, there were
25 differences in interpretation about what was required and

1 how you actually met the regulation.

2 From my personal perspective, I got introduced to
3 Appendix R, I think, in 1985, and the issue that we dealt
4 with back in that timeframe was fire zone boundaries were
5 not adequate to prevent the spread of fire. So we went from
6 fire zones to the fire areas that I showed you on the
7 previous slide.

8 And after having spent probably 50 or 60 million
9 dollars to configure the plant to the way we thought met the
10 regulations during the licensing phase, we had an inspection
11 shortly after going into operation, where we found out that
12 we had missed the boat on the fire area/fire zone issue.

13 We went back in that timeframe and spent about 20
14 or 25 million dollars upgrading fire barriers and evaluating
15 those components in the fire barriers that weren't there.

16 We then transitioned into the '90s, when we had
17 the issues with the Thermo-Lag fire barrier materials and
18 the circuit analysis issues and the use of low pressure
19 systems, and we're just finishing up now another 25 million
20 dollar effort to bring that to a close.

21 The thing we found, even amongst ourselves, as we
22 got together as peers and colleagues and we would discuss
23 these issues amongst ourselves, none of us really agreed.
24 We spent a lot of time hashing out the requirements, the
25 regulations, what does this mean, what does that mean, how

1 do you do this, and I guess that's one of the things that we
2 think is good and is significant about the guidance document
3 we put together.
4 We've got half a dozen people out there now that
5 can all get together and talk about these things and speak a
6 common language and understand what we're talking about, and
7 I think the more of that we can do, the better off it's
8 going to be not only in terms of not having people
9 constantly revisiting these issues, but once people
10 understand what it is that they're supposed to be doing in
11 order to satisfy regulations and make plants safe, that
12 they're usually pretty good about doing it.
13 DR. APOSTOLAKIS: Now, you don't expect an FPA-805
14 to force you to spend another 25 million, do you?
15 MR. GORMAN: I don't expect that, no. But I just
16 do what they tell me, George. So if I've got to do it, I go
17 to work and pick that pencil up.
18 DR. POWERS: Let me pursue this a little further.
19 The criterion for safe shutdown in a boiling water reactor
20 involves not letting the coolant drop below the top of
21 active fuel.
22 MR. GORMAN: For alternative shutdown, yes. It
23 doesn't say that for redundant, however.
24 DR. POWERS: Does the combination of SRV and low
25 pressure injection systems assure you meet that?

1 MR. GORMAN: It depends on how you're shutting
2 down a plant. If you're shutting down your power plant and
3 you're following your emergency operating procedures, as we
4 would expect the operators to, because that's how they are
5 trained, they will not initiate their ADS systems, they will
6 not depressurize with their SRVs until they get to levels
7 that would give you an indicated water level of less than --
8 lower than the top of active fuel.
9 DR. POWERS: But doesn't that just preclude using
10 this as an alternative?
11 MR. GORMAN: Our position has been that it's
12 acceptable as a redundant shutdown. I believe -- I don't
13 want to speak for the staff, but I think it was accepted
14 with -- if you're provided an exemption, there were memos
15 out there that say it's okay for alternative shutdown,
16 because it's a momentary uncovering of the core and even
17 though you uncover the core for a minute, two minutes,
18 you're not going to get temperatures that are anywhere near
19 temperatures that could damage the core.
20 DR. POWERS: But the uncovery signal that's
21 received by the operator initially is a manual action. Is
22 that correct?
23 MR. GORMAN: No. He does a manual action based on
24 an indicated water level.
25 DR. POWERS: That's right.

1 MR. GORMAN: So he's monitoring that, yes.

2 DR. POWERS: He gets an indicated water level that

3 he is close to or actually under the top of the core.

4 MR. GORMAN: Of the active fuel, right.

5 DR. POWERS: Understand that this is a collapsed

6 water level that he's reading, right?

7 MR. GORMAN: He's reading the downcomer water

8 level and in the core, you're going to have a void fraction,

9 which is going to be a mixture of steam and water, which is

10 generally a few feet higher.

11 DR. POWERS: We're really not uncovered.

12 MR. GORMAN: Right.

13 DR. POWERS: But based on collapsed level, we are.

14 But it initiates a manual action. Doesn't that raise the

15 question of what you just said in that?

16 MR. GORMAN: He's trained to do that per his

17 procedures, regularly trained on that particular aspect of

18 it.

19 DR. POWERS: There are a lot of other things going

20 on that you don't train with. You don't have a fire going

21 on in your simulator when he has to do this.

22 MR. GORMAN: That's true.

23 DR. POWERS: And there's not a lot of smoke and

24 things like that going on, not a lot of other additional

25 things that could make it difficult for him to get around.

1 MR. GORMAN: But everything he's doing in response
2 to the fire is generally a manual action on the part of the
3 operator. Many of those actions are actions that he takes
4 in the control room. Some of those actions are actions
5 where individuals -- he could leave the control room, go to
6 local stations in the plant and to take actions.
7 The analysis is predicated on those actions being
8 performed. I guess our position would be that many of the
9 conservatisms that we've already talked about, we expect
10 never to get to this point. We consider this to be a
11 hardened path.
12 We consider if things get to this point, the
13 operators will take those actions that are appropriate.
14 DR. POWERS: What I'm wondering about is that in
15 thinking about the general conservative approach, maybe we
16 said, yeah, maybe it's true, you've got a foamed level here,
17 there's plenty -- provides plenty of cooling, in truth.
18 MR. GORMAN: Right.
19 DR. POWERS: Even if your collapsed level is some
20 small fraction below. But there are so many other things
21 that I can't take into account, that there's an element of
22 conservatism to account for things that I just really can't,
23 I just don't want to mess with and the analysis makes it too
24 complicated.
25 I just take that as the point and it's really not

1 that specific thing I'm protecting against. It's all these
2 other things, these imponderables that I've come about.
3 MR. GORMAN: I'm not sure I'm following you on
4 that.
5 DR. POWERS: Well, people have to go to other remote
6 locations and carry out actions and they can't get there,
7 there's some difficulty in getting there, the timing is not
8 right, instruments don't always indicate what you think
9 they're indicating in fire situations, a whole bunch of
10 other things.
11 So just as an element of conservatism, I just take
12 this line, the uncovery of top of active fuel, to assure
13 that there's a high degree of confidence that everything
14 will go to keep this core cooled.
15 MR. GORMAN: And that can be -- I mean, that could
16 be done. If you blow down from a higher level, then top of
17 active fuel, then you won't even go -- indicated level will
18 not even go below the top of active fuel.
19 The dilemma you get into there is now you're going
20 to have to start telling your plant operators that there's
21 something special about this condition. That can be
22 interpreted to mean that there is something wrong with doing
23 it the way the EOPs tell them to do it.
24 Typically, the people in the control room are
25 trained, they're very good people, they believe everything

1 that the engineering people tell them and then when you come
2 along with a major change like that, it makes them think
3 that they haven't been told the right thing, and it's a
4 concern from that perspective.
5 DR. POWERS: I think you're driving toward a
6 crucial point to consider here. There are a lot of other
7 abnormal events that get you into emergency operating
8 procedures. I assume that's true.
9 MR. GORMAN: Right.
10 DR. POWERS: And the fewer "if this, then this"
11 claims of things that you have in those, the more likely it
12 is that the EOPs will be religiously followed.
13 MR. GORMAN: Right. And they're really considered
14 to be sacred and if you start doing things different than
15 those, then it's --
16 DR. POWERS: I'm just thinking of the procedures
17 themselves, because I'm following it, but I have to make
18 judgments on, well, this is a fire, so I go off and do this
19 thing as opposed to something else that I do over here.
20 What you're proposing is to stay more consistent.
21 MR. GORMAN: Right.
22 DR. POWERS: So that there's a smoother flow here.
23 Now, it seems to me that's a very crucial point.
24 MR. GORMAN: It is, and really the reason why we
25 have the symptom-based emergency operating procedures is

1 because we don't went the operator in the control room
2 trying to guess what it is that's going on in the power
3 plant.
4 You mentioned instrumentation and, generally, what
5 we do relative to instrumentation is we have to identify
6 instrumentation that is not going to be impacted by the fire
7 and we have to tell the operator if the fire is in this
8 location, this is what you look at.
9 So if there are other instruments that are giving
10 them conflicting information, he should go back to the ones
11 that he's been told are the protected ones.
12 DR. POWERS: That gets you back into diagnosis.
13 MR. GORMAN: Yes.
14 DR. POWERS: It's hard sometimes to tell where a
15 fire is.
16 MR. GORMAN: Right.
17 DR. POWERS: But this idea of consistency and
18 fewer paths that you follow, then the EOP sounds like a very
19 strong argument.
20 MR. GORMAN: That's the one that the operations
21 engineering procedures people supply to us whenever we make
22 a suggestion that we want to do something different, and
23 it's --
24 DR. POWERS: I would have a -- you would have to
25 argue with me pretty long and loud to get me to put "if

1 then" statements in the EOPs.

2 MR. GORMAN: Right. How am I doing with time

3 here, Jit?

4 MR. SINGH: You've got one more.

5 MR. GORMAN: I've got an hour? Okay. General

6 discussion on our view of post-fire safe shutdown, some

7 discussion on the circuit failure modes that we looked at,

8 circuit types that we look at, a couple of examples of

9 circuits, one example of a safe shutdown system, a little

10 discussion on the circuit failure phenomenon, and our

11 conclusions.

12 Our stated goal in our guidance document is that

13 the fission product boundary should not be affected and

14 there should be no fuel clad damage, no rupture to primary

15 coolant boundary or rupture to primary containment.

16 We do that by assuring that we can control

17 reactivity pressure, inventory, we can remove the decay

18 heat, and that we have process monitoring and support

19 functions that are necessary to back those primary functions

20 up.

21 In addition to protecting that hardened path, we

22 also look at spurious operations that could give us a loss

23 of inventory from the vessel or that could give us a flow

24 blockage or a flow diversion in the systems that we're using

25 for inventory makeup and decay heat removal.

1 So the guidance document we've put together
2 provides a methodology for identifying the equipment and the
3 cables that need to be investigated for the Appendix R safe
4 shutdown, post-fire safe shutdown analysis.
5 We evaluate each of the conductors and each of the
6 cables when they get into the wrong location for the effects
7 of a hot short or short to ground or an open circuit.
8 If any of those failure modes provides an impact
9 to that piece of equipment so that it won't be able to
10 perform its required safe shutdown function, then we provide
11 a means of mitigating the effect on that piece of equipment
12 and we believe this approach is also an approach that has
13 been consistently applied by licensees.
14 After we got to the point where we refined our
15 language and were able to communicate amongst ourselves, it
16 became apparent that the BWRs were fairly consistent in this
17 approach.
18 Through the effort we're involved in with NEI, the
19 PWRs have also looked at the guidance document and they
20 believe it's consistent with the way they have conducted
21 their business.
22 The circuit failure modes of concern are an open
23 circuit, where we'll just lose electrical continuity and we
24 won't be able to operate a particular piece of equipment.
25 Short to ground, where you could lose the power supply to a

1 control circuit, the power to the mode of force for a piece
2 of equipment, that would prevent equipment from operating.
3 The hot short, which is most often the culprit in
4 terms of making things happen that you don't want to happen.
5 And then high impedance faults, which are restrictive faults
6 that, in power feeds to equipment, where the fault current
7 does not reach the level of the protected device, the
8 breaker, the fuse or whatever on that particular circuit.
9 And the concern with high impedance faults is that
10 if you get a bunch of them -- we'll go into a little bit
11 more detail in a minute -- but if you get a bunch of those,
12 where you don't trip the protected device, you could, by
13 adding up these series of currents that are just below the
14 protected device, exceed the capability of the protected
15 device that feeds the bus and then lose the bus.
16 And we'll get into this a little bit later, but
17 we've made a recommendation that we don't think this needs
18 to be considered any longer. It has been, but we don't
19 think it's worth continuing.
20 DR. APOSTOLAKIS: What does the M stand for?
21 MR. GORMAN: Multiple.
22 DR. APOSTOLAKIS: Multiple.
23 MR. GORMAN: So if you take one of those a number
24 of times, you get a bunch of them. We have a figure later
25 on, that I will try to explain that a little bit better.

1 So we look at power circuits. We look at
2 instrumentation circuits and control circuits and primarily
3 what I'm going to concentrate on here today would be the
4 control circuits.
5 As I said, for the instruments, we typically are
6 forced to identify to the operator what instrument is
7 protected, and that's the instruments that he's supposed to
8 be relying on.
9 With respect to the power circuits, three-phase
10 hot shorts have not been required to be looked at, except
11 for conditions at high-low pressure interface, where you
12 could open a number of valves and you could have essentially
13 a fire-induced LOCA to the downstream piping.
14 We've made a recommendation in our document that
15 we don't even believe those need to be considered for the
16 high-low pressure interface, because we think they're low
17 enough probability.
18 MR. SIEBER: When you are making these kinds of
19 recommendations, like the high impedance fault, do you have
20 analysis that demonstrates that these kinds of faults,
21 three-phase shorts and so forth, are not credible or do you
22 just imagine it and say I don't think it's credible and this
23 is what we ought to recommend?
24 MR. GORMAN: We've provided an appendix in the
25 back of our guidance document for the multiple high

1 impedance fault issue, to say that we believe that the high
2 impedance fault, in and of itself, is a low probability
3 occurrence and to take a whole bunch of them and to have
4 them all add up to the point where they trip a feeder
5 breaker for a bus we think is not real.
6 So this is a slide we use to explain our basic
7 criteria and with the basic criteria, we start with the
8 nuclear power plant. We extract those functions that we
9 need for safe shutdown, which are reactivity control,
10 pressure control, inventory control, decay heat removal,
11 process monitoring and support functions, and we take a look
12 at the potential spurious operation concerns, which we
13 define as the loss of the reactor pressure vessel inventory
14 or a flow blockage in our safe shutdown systems.
15 Having identified those systems, we then identify
16 a minimum of two independent ways to satisfy those
17 functions. We identify the systems that are necessary to
18 perform those functions and then the equipment that is
19 necessary to have those systems function the way they need
20 to in support of post-fire safe shutdown.
21 And then having identified the equipment, we then
22 go to electrical schematic drawings, where we identify the
23 cabling that's associated with a particular piece of
24 equipment and when we look at those electrical schematics,
25 we occasionally will find an interlocked circuit where there

1 would be an auxiliary circuit, separate from what's shown in
2 the primary schematic, that could have an impact on the
3 performance of that particular component.
4 We identify the circuits associated with that
5 interlock scheme and assign those to the particular piece of
6 equipment.
7 We also identify the control power necessary for
8 the circuit to work and we identify the mode of force for
9 the pump, the valve, the whatever that is necessary, that
10 we're trying to have operate for us.
11 And when we start looking at that mode of power
12 sources and the control power sources, that's where we kind
13 of get into an additional group of equipment out of our
14 electrical distribution system.
15 So we start out with systems. We identify
16 components off of P&IDs. We then identify cables that go
17 with that and as we identify these cables, we also now
18 identify that there are large pieces of electrical
19 distribution equipment that are also necessary to support
20 post-fire safe shutdown and these go all the way from the
21 120 volt A/C power supply all the way up either to the
22 off-site power source or to the emergency diesel generator
23 power source.
24 So to make a particular valve work for us, we need
25 to have circuits all the way down from the ultimate power

1 source, either off-site power or the diesel generator, we
2 can't have impacts to those, can't have impacts to any of
3 the control circuitry, and we can't have any impact to the
4 specific cables associated with that component.
5 DR. APOSTOLAKIS: When you say you can't have any
6 impact, do you mean that cables and the circuits are
7 completely outside the fire area you're considering or there
8 are some of those there, but you will show some analysis
9 that they will not be impacted?
10 MR. GORMAN: Well, we'll do a couple of things.
11 We'll either -- if you identify the circuits in the area,
12 you can always reroute the circuit. You can put a fire
13 barrier. You have a cable tray running through there. One
14 of the circuits you're concerned with is a circuit that's
15 required to perform a function. You put a raceway fire
16 barrier on there. You could perform a manual action in some
17 cases.
18 DR. APOSTOLAKIS: But in the case that you are
19 arguing, the SRVs and low pressure systems, what is your
20 basic thesis; that there isn't a single fire area that will
21 affect these circuits?
22 MR. GORMAN: Our basic thesis there is that that
23 is an acceptable group of systems that we can start with up
24 here with the capability to perform these functions.
25 DR. APOSTOLAKIS: Right. But then --

1 MR. GORMAN: Once we do that, once we have
2 identified -- and the discussion has been we've said yes,
3 staff has said no. What we have done with it is we have
4 gone through and treated those systems identical to any of
5 the other systems in terms of identifying what equipment is
6 necessary, what cable supports that equipment, and we treat
7 those systems identically throughout this process.
8 DR. APOSTOLAKIS: But there are fire areas in the
9 plant where you have to go through these mitigation
10 techniques for these two systems.
11 MR. GORMAN: And other systems, also, yes.
12 Whatever you use. I don't know --
13 DR. APOSTOLAKIS: Some are outside, I mean, that
14 you have assured that will not be affected. There are some
15 areas where some further analysis is required.
16 MR. GORMAN: Typically, the way this happens --
17 DR. APOSTOLAKIS: It wasn't clear from the report.
18 MR. GORMAN: Which one?
19 DR. APOSTOLAKIS: That's what I'm asking myself,
20 which one. And the disagreement with the staff is where?
21 MR. GORMAN: Up at this level. Can we use SRVs
22 and our low pressure systems to accomplish these functions
23 in a redundant shutdown fire area? So if you're in the
24 control room and the fire is in some place outside the
25 control room, is it acceptable to go out and to protect the

1 stream of equipment, cables, whatever that you need in order
2 for that to be your protected safe shutdown system?
3 DR. APOSTOLAKIS: That's not very clear to me.
4 Are we going to hear from the staff today?
5 MR. SINGH: No. Tomorrow.
6 MR. GORMAN: I think I said that right, didn't I?
7 I hate to be talking for you guys.
8 MR. WHITNEY: Leon Whitney, Plant Systems Branch.
9 There's two basic areas of disagreement. One is in the
10 SRV/LPS area, but there's also the associated circuit
11 analysis issues, which we will talk about tomorrow. So
12 there's two basic areas of disagreement.
13 MR. GORMAN: Good. And those -- the second set of
14 disagreements related to circuit analysis manifests itself
15 down here. So we're first trying to -- with the SRV/low
16 pressure system issue, we're trying to decide what are
17 acceptable shutdown methodologies to be included up here and
18 then after we get that settled, you take those systems,
19 equipment, cables, you put them through this process, and
20 then we have some discussions that we've been having
21 relative to how you analyze those circuits.
22 Let me introduce this one. So essentially, when
23 you get into this electrical distribution system equipment
24 over here and the topic of associated circuits, common power
25 supply, what we're really talking about there is it's

1 essentially breaker coordination.

2 If you have two separate fire areas, you have a
3 power cable for safe shutdown pump train A in this fire
4 area, separated from the adjacent fire area that contains
5 safe shutdown pump train B, we need to make sure that if
6 another power cable off of this bus enters this area, that
7 if this cable were to burn up, short to ground, that this
8 breaker is coordinated with this breaker, so that this
9 breaker would open for all credible faults over a time
10 current spectrum, and not cause this breaker to open,
11 because of this one opened, then we would indirectly lose
12 power to this pump by virtue of this condition here.

13 So that's the electrical distribution system
14 concern.

15 And then Generic Letter 86-10 introduced the
16 concept of a multiple high impedance fault, where even if
17 these breakers were coordinated with the feeder breaker to
18 the bus, we needed to postulate a restricted fault on each
19 one of these circuits, and that restricted fault doesn't go
20 -- doesn't have an amperage rating greater than 20, so it's
21 not going to activate this breaker.

22 And the concern is, for example, if you've got 16
23 amps on this circuit, 16 amps on this circuit, 16 amps on
24 this circuit, and you had running amps to make this pump
25 operate over here of 15 and you had some other running

1 current off of another breaker equal to 15, I think that
2 gets you up to about 78 amps.
3 That would be very close to tripping this. The
4 real concern if this were 20 and this were 20, then the
5 combination of 16 amps, 16 amps, 16 amps, 20 amps and 20
6 amps would be above the long-term setting on that breaker
7 and that that breaker could be, again, tripped and we would
8 lose power to our safe shutdown systems.
9 The discussion we provided in our guidance
10 document was relative to the likelihood of one of these high
11 impedance faults and we believe that when you start taking a
12 bunch of these high impedance faults, and particularly when
13 you have to assume current levels up to -- some people
14 assume up to 80 percent of the load breaker rating, we don't
15 really think that's a credible scenario.
16 And it's also an area, when you put one of these
17 analyses together, where you're forever going back and
18 changing it every time you change a running load on
19 something.
20 So you put a new relay in and the amperage draw on
21 that relay goes from 3.4 amps up to 3.7 amps and you go back
22 and you redo that.
23 Now, not everybody does a rigorous analysis of
24 that. There are some that use an approach of rather than
25 dealing with that particular scenario, they just have

1 procedures in place that say if I lose the bus, I will -- if
2 this thing were to happen, what I'd do is I'd go open this,
3 open this, open this, open this, this would already be open
4 by fire-induced failure, and then I would close the breaker
5 and the breaker supply to the equipment I needed.
6 So that's the effort that we prescribe to people
7 that walk through, with the exception of we no longer
8 recommend that multiple high impedance faults be looked at.
9 So we identify the cables to the equipment for the
10 systems. We then have to find out where in the plant those
11 circuits are located, so we know essentially, on our own
12 basis, where the raceway are, we know what cables are in
13 which raceways, and by virtue of that information, we can
14 figure out how many improperly routed circuits of each
15 particular shutdown methodology are impacted in any fire
16 area.
17 And, generally, what is done is people pick the
18 one with the least number of problems. Then we perform a
19 circuit analysis on the ones with the least number of
20 problems. When we do the circuit analysis, we take the
21 cable, improperly loaded cable, we look at each conductor in
22 that cable, and we look at it for the effects of the hot
23 short, short to ground or an open circuit.
24 If any one of those prevents -- causes an impact
25 to the equipment that prevents it from being able to perform

1 its function, we drop it into our equipment impact bucket
2 and then with respect to our equipment impact bucket, we
3 provide a mitigating technique for each piece of equipment
4 that ends up in there.
5 We re-route the circuit. We wrap it. We perform
6 a manual action. Under certain limitations, we're allowed
7 to make repairs. Sometimes you can pick another piece of
8 equipment that could perform the same function and then
9 sometimes you can get into these 86-10 fire hazards
10 evaluations or you can get into an exemption request, if
11 you're a pre-1979 plant, or a deviation request, if you're a
12 post-1979 plant, and you would like staff concurrence on
13 your actions.
14 So essentially, our guidance leads people to the
15 point where they identify cabling that is located in an area
16 where it is required to support the safe shutdown path
17 that's being used for post-fire safe shutdown in that
18 particular area, and it instructs them to evaluate the
19 conductors in the cables for the effects of a hot short,
20 short to ground, or an open circuit.
21 And if any one of these failure modes gives you an
22 impact to the equipment's ability to perform its safe
23 shutdown function, then you need to provide a means to
24 mitigate that effect.
25 Then we have three examples. One is an ungrounded

1 MOV circuit -- I'm sorry -- a grounded MOV circuit, an
2 ungrounded MOV circuit, and then a P&ID for safe shutdown
3 system.
4 Grounded control power, a fuse of some size
5 associated with it, and this would be a simplified MOV
6 control circuit, where you'd have a an open coil that you
7 get energized through either closing the control switch or,
8 in some cases, an interlock from an auxiliary circuit, or
9 same thing on the open side, with just the control switch.
10 And when we test our criteria relative to these
11 types of things, if the cable containing this conductor in
12 it were found in the area, we would postulate hot short,
13 short to ground, or open circuit.
14 Postulated short to ground up here would blow the
15 control power fuse and we would not be able to operate this
16 piece of equipment.
17 Similarly, an open circuit up here would prevent
18 us from operating the equipment. If we had a hot short, hot
19 short on the top part of this diagram would not affect any
20 of the stuff below it, because we have open contacts and
21 open control switches.
22 So essentially, to get a spurious operation on
23 this particular circuit, we can get it by energizing that
24 particular conductor with either a hot short from an
25 adjacent conductor in the same cable or from another

1 conductor of some sort, and, typically, people, when they
2 look at these schematic diagrams, don't go to the point of
3 identifying where the hot short potential is going to come
4 from, they just say this particular conductor, if it were to
5 get a hot short, could give me a spurious operation and this
6 particular conductor is in the cable that's in the fire area
7 that I'm relying on.
8 So that is a potential for a spurious operation.
9 Now, as you look at this schematic here, and I've
10 got a real life one over here, if anybody needs to see that,
11 not all of these conductors that are shown here are in the
12 same cables or all in the same areas.
13 So you may have this conductor here and this
14 conductor here being in the same cable.
15 Some of these conductors up here are going to be
16 in other locations, some of the conductors are going to be
17 in cables that run from valve to MOV, MOV back to control
18 room.
19 So it's put together as an integrated schematic on
20 how the device works, but it's not a physical depiction of
21 what's actually out there.
22 And then typically the control panel will come in
23 from a separate circuit into the particular location where
24 the controls are located.
25 Now, if you take an ungrounded control circuit,

1 again, you take the short to ground up here, nothing is
2 going to happen, because there is no ground down here to
3 give you the tie to ground.
4 What our criteria has said, if you have an
5 ungrounded control circuit and you get a short to ground on
6 it, you need to assume that that short to ground is going to
7 cause your control power fuse to blow. So that don't
8 assume, just because you need one up here and you need one
9 at a lower location, that you don't have the lower one. Our
10 guidance is if you get one, assume it's a problem.
11 Then similarly, with a hot short to either open or
12 close this valve, if you get a hot short here from an
13 external source and it's not off of the same control power,
14 then nothing is going to happen, because it's not going to
15 complete the electrical circuit loop.
16 In that case, what our guidance has said is that
17 if these circuits are located in areas where they have the
18 potential to spuriously operate, our guidance tells people
19 assume that the hot short that you get at that point comes
20 from the same source and, therefore, that single hot short
21 does have the potential to cause the spurious operation.
22 So when we look through these types of diagrams,
23 our basic conclusion is that when we go back to our -- when
24 we go back to our basic methodology here, we think when we
25 apply a circuit analysis criteria like that, we're going to

1 get what equipment impacts are important to be identified.
2 And, again, once we identify those impacts, any
3 impacted equipment, either because it has to perform one of
4 the required safe shutdown functions or it could spuriously
5 operate and affect the safe shutdown function, we would put
6 in our equipment impact bucket and we would, on a
7 one-at-a-time basis, mitigate those effects.
8 So if you look, again, at a simplified P&ID, if
9 this were our inventory makeup system for safe shutdown in a
10 particular area and if this valve were impacted so that it
11 were not able to perform its function, our makeup system
12 would not be available, we would need to do something about
13 this.
14 Same thing with the pump, same thing with this
15 valve, same thing with any of the injection valves. If the
16 min flow valve was an issue, we would also need to make sure
17 that would be protected.
18 So, again, basically, with respect to the safe
19 shutdown functions, one at a time is going to give us an
20 impact to the system and that one is going to require us
21 then to go do something about that particular impact.
22 The point of contention comes in where you might
23 have a path that would represent a flow diversion off of
24 this primary path, if you had two normally closed and two
25 required closed paths, the industry position essentially

1 looks at that condition as a fire hardened condition that
2 some people would look at that initially up front in their
3 analysis and they would not even have included these
4 components into this portion of the equipment evaluation.
5 And the basis for that was that it's going to take
6 two spurious operations in order for those particular valves
7 to go open.
8 So why do we think we have a good criteria here?
9 I guess some of the reasons that we think it's good and we
10 think it's safe is because of the assumptions used in the
11 post-fire safe shutdown analysis that we discussed earlier
12 related to the extent of fire spread, to equipment damage,
13 and when we compare those with the defense-in-depth approach
14 that we take for fire protection, to get to the point where
15 we're even damaging equipment and utilizing these systems,
16 the expected fire size we don't think is capable of getting
17 us there.
18 The extent of spread should be limited and the
19 extent of equipment damage should be significantly less than
20 what we have.
21 With respect to the hot short, our view of the hot
22 short is that it's really an engineered circuit failure and
23 we believe, based on this parameter, that it's a low
24 probability.
25 So essentially the fire has got to reproduce what

1 it takes numbers of engineers doing series of calculations
2 in order to get the circuits to perform, the fire has got to
3 have the capability to reproduce that, and I'll try and step
4 through some examples of this.
5 So with respect to actual fire effects, generally,
6 we're dealing with large areas with high ceilings. If you
7 take a plant like Susquehanna, you've got a 645 elevation,
8 you've got a 670 elevation, 683, 719, 749, 779. So in
9 general, you're incrementing 25 or 30 foot ceiling heights.
10 On most of the elevations, there are large open
11 areas that are a hundred feet by a hundred feet. When we
12 look at that particular parameter and we look at, well, what
13 kind of temperatures are concerned about relative to fires,
14 if we go off and we do a fire test to ASTME-119 and we use
15 the most current criteria, the acceptance criteria on the
16 cold side of the barrier for a single point hot spot is 325
17 degrees plus ambient.
18 So 400 degrees is an acceptance criteria for cold
19 side on the fire barrier. Conversely, if you didn't have a
20 fire barrier, you didn't have 400 degrees, I think the
21 implication would be that there's not really a concern for
22 the circuits.
23 Cable ignition temperatures are, from what I've
24 seen, in the 700 to 900 degree range.
25 DR. APOSTOLAKIS: But isn't it really the damage

1 temperature that's of interest rather than the ignition,
2 which is lower? You don't have to ignite to have damage.
3 MR. GORMAN: Right. But this would be of a
4 concern relative to igniting things and then maybe having
5 some degree of spread.
6 DR. APOSTOLAKIS: Oh, for spreading.
7 MR. GORMAN: Yes. So if we even used this as a --
8 this is what the fire barrier testing on the cold side of
9 the barrier would conservatively use as a single point worst
10 case temperature and the implication being that 400 or below
11 for a single point would not damage the circuit.
12 And then to melt conductors, you're talking 1,800
13 to 2,000 degrees Fahrenheit for copper. So when we look at
14 these --
15 DR. POWERS: You could find one and say to
16 catastrophically vaporize, it takes 3,000 degrees Kelvin and
17 things like that. I don't see what the pertinence of the
18 melting point is.
19 MR. GORMAN: A lot of these guys had trouble with
20 this slide, too.
21 DR. POWERS: I mean, the plasma temperature, we
22 could get some really astronomical temperatures here.
23 MR. GORMAN: I guess the point is that if we take
24 a look at how we limit the amount of combustibles that we
25 allow into the power plant and how we control the

1 transients, the fact that we have high ceilings in large
2 areas with the equipment not being located generally on the
3 floor, the expected size fire, so even if you took a 500
4 kilowatt fire, I believe that if you went ten foot above the
5 fire, you'd be under about 500 degrees for a plume
6 temperature.
7 DR. APOSTOLAKIS: But you haven't really done
8 those calculations, have you?
9 MR. GORMAN: I've seen copies of ones that people
10 have done, yes.
11 DR. POWERS: I guess I'm perplexed. I mean, we
12 have fires. We have fires in big areas. We know what they
13 do to things.
14 MR. GORMAN: Right.
15 DR. POWERS: What kinds of temperatures are
16 encountered where things get damaged and you get circuit
17 failures?
18 MR. GORMAN: And we're not saying we're not going
19 to get circuit failures. We're just saying that we would
20 expect to have localized effects based on the design of
21 these facilities, based on the control of the combustibles,
22 based on what those combustible materials are that are in
23 the plant.
24 And if you don't have -- if you have localized
25 effects, then you shouldn't be involving many, many circuits

1 involved in your fire scenario.

2 DR. POWERS: But how many circuits go through that

3 localized area.

4 DR. APOSTOLAKIS: In a natural application, you

5 would have to go into the big area and find the actual

6 locations where a fire may do the most damage. Is that

7 correct?

8 MR. GORMAN: That's --

9 DR. APOSTOLAKIS: It's not a general qualitative

10 statement.

11 MR. GORMAN: Right.

12 DR. APOSTOLAKIS: You would say look for places

13 where important cables come together or the closest and then

14 you look there and without doing any thermal calculations,

15 following this guidance, you would say, well, I assume I

16 lose this or you're losing everything in the area.

17 MR. GORMAN: Well, we assume, like I said in the

18 beginning --

19 DR. APOSTOLAKIS: The whole area is lost.

20 MR. GORMAN: We assume that things in the area are

21 damaged. We assume that things that are unexamined in the

22 area, that they're all damaged.

23 DR. APOSTOLAKIS: If that doesn't work, then you

24 said you may have special analysis.

25 MR. GORMAN: You can do special analysis. You

1 could do special analysis and do something like this, that's
2 correct. And one of the problems we get in a real good risk
3 profile is that you don't have the detailed information on
4 the exact location of all your circuits.
5 I mean, like I said before, we generally know that
6 they're in this room, but you don't have detailed
7 information. In order to do the risk profile for an actual
8 design fire, design basis fire, we'd have to know are they
9 over there in that corner, down close to the floor, or are
10 they over here and what's the relationship between them.
11 And in addition to that, to do it thoroughly, we
12 would have to go back and take those other 23 or -- 22 or
13 23,000 components that we haven't put through this pyramid
14 approach and we would have to identify all the relationships
15 between those components, their systems, their circuits,
16 their circuit locations.
17 So it's a fairly massive effort to get to the
18 point where you can come up with a real good sense of what
19 the risk numbers are.
20 This is our way of truncating that analysis.
21 DR. APOSTOLAKIS: Outlier areas means what?
22 MR. GORMAN: If you have an area where you think
23 you have a small room or you have the potential for a big
24 fire, rather than going in there and trying to revise
25 circuit failure criteria and do things along those lines, we

1 think it would be better to increase the defense-in-depth
2 measures in those areas where you could have a problem.
3 DR. APOSTOLAKIS: Which does not necessarily mean
4 doing things outside area. You could protect circuits in
5 that area by blocking them up with --
6 MR. GORMAN: And you may want to get the circuits
7 outside of that area and then you may want to go in and say,
8 well, for this area, I want to put a deluge system in over
9 top of my HPSI and RCIC turbines because they got 165,000
10 gallons of oil in them.
11 So this is our discussion on the circuit failure
12 phenomena, and what we're going to talk about here is the
13 hot short and what we're showing here are two independent
14 circuits, but they could be two circuits within -- two
15 conductors within a common cable. It doesn't have to be
16 independent.
17 And I guess the point here is that we have
18 electrical engineering people that do a lot of analysis to
19 make sure that the power supply and the fuse sizes, the
20 cable lengths, the contactor or equipment characteristics
21 are all in sync, so that these things properly function when
22 an operator closes a switch and makes them go into that
23 mode.
24 So there's a lot of engineering that is put into
25 these things. So if we looked at those two circuits and

1 then if we postulated a fire starting that would affect the
2 insulation on each of those conductors and those conductors
3 starting to close to contact each other, what we would end
4 up with would be an introduction of two variable resistors
5 into the circuit.
6 One would be a variable resistor associated with
7 the insulation resistance on the conductor and then the
8 other one would be if they got to the point where there were
9 contact between the two conductors, the variable resistance
10 associated with the contact resistance.
11 And since there is a common ground, there could be
12 some communication between the grounds.
13 So if those circuits were to come together, then
14 you could establish a current flow path from the power
15 supply on your right through these variable resistors that
16 could actuate a device that maybe would start a valve
17 opening, start a valve closing, and then the return flow
18 path back to the power supply could be through the ground.
19 So if we draw an equivalent circuit for that,
20 borrowing the NEMA-1 contactor from what used to be on the
21 left side circuit and putting them in series with the
22 variable resistance for insulation and variable resistance
23 for contact, and then looking at the characteristics that
24 the manufacturer gives us relative to his device, we can
25 maybe draw some conclusions or at least make some points.

1 The impedance associated with that NEMA-1
2 contactor is 138 Ohms and the manufacturer tells us that it
3 will work in a voltage range between 102 and 132 volts.
4 So if we have 120 volts across the system based on
5 the capability of the power supply, that tells us we need
6 102 volts across the contactor for the contactor to pick up
7 and actually cause the spurious operation to occur.
8 That leaves 18 volts as the voltage drop across
9 the two variable resistors.
10 Now, if we take this 102 volts and we divide it by
11 the impedance on that contactor, we find out that the
12 in-rush current, in order to get that contactor to pick up,
13 is close to three-quarters of an amp.
14 And then if we take that in-rush current and apply
15 it to this voltage, we find out that the combined effect of
16 those two variable resistors has got to be less than or
17 equal to 24 Ohms.
18 So for a spurious operation to occur, we need to
19 take the insulation resistance on these conductors, which is
20 essentially infinite, and we need to make that go down to 24
21 Ohms before some other kind of a failure occurs.
22 DR. POWERS: If the contactor is hot, is it still
23 138 Ohms?
24 MR. GORMAN: I'm not sure, Dana.
25 DR. POWERS: I don't know which way it goes. But

1 doesn't that have to be taken into account in the analysis?
2 MR. GORMAN: What are you looking at in terms of
3 heating up the contactor?
4 DR. POWERS: Well, just a hypothesis.
5 MR. GORMAN: If this were -- that may be a
6 consideration. I don't have an answer for you on that one,
7 but I can --
8 DR. POWERS: It's not worth pursuing. Just a
9 question.
10 MR. GORMAN: So basically we're looking at some of
11 our gut judgments relative to these types of circuit
12 failures that cause spurious operations. They really have
13 to -- the fire itself has to do things that reproduce
14 engineered activities and they're doing it in an environment
15 where it's probably not going to be the cleanest environment
16 in terms of smoke generation and all those types of things.
17 DR. POWERS: I mean, the anthropomorphization of a
18 fire is an interesting concept. If I carry this on far
19 enough, then I conclude that fires never do anything.
20 MR. GORMAN: Right.
21 DR. POWERS: But I know that's wrong. I know
22 fires cause spurious operations. Is this really a
23 productive line of reproach? Unless I have a big database
24 that says here is what fires do and don't do, and maybe
25 Steve can share with us a big database on what fires do and

1 don't do, it seems to me that I'm attributing an
2 intelligence to fires that they don't have to argue that
3 things don't occur.
4 I mean, I'm going to have bumblebees not flying
5 here pretty soon and things like that.
6 MR. GORMAN: That's true. Well, I guess,
7 basically, these are the kind of -- these are the kind of
8 arguments that I think reasonable people could provide and
9 from our perspective, we went through our methodology,
10 discussed, in numerous meetings, with the NRC the
11 methodology, and got down to the point where we were not in
12 agreement.
13 There were some disagreements relative to the
14 number of spurious operations, the number of circuit
15 failures.
16 We're then at a point where as we looked through
17 the regulations, we didn't believe that we were doing
18 anything that was inconsistent with the regulation that
19 wasn't accepted.
20 So we now have to go back and speak with
21 executives to provide funding and many of those people are
22 -- they're sharp enough to draw those types of pictures for
23 us, why would I want to go off and spend that kind of money
24 in order to address an issue that has apparently not very
25 high safety significance.

1 And we're not able to demonstrate that there's low
2 safety significance associated with it. We just think
3 there's an absence of information.
4 DR. POWERS: An interesting dilemma. You can't
5 demonstrate high safety significance, so you can't get money
6 to work on it. You can't demonstrate low safety
7 significance, so you can't not work on it. It's an
8 interesting dilemma.
9 MR. GORMAN: That's why we call Fred, because he's
10 very good at that kind of stuff.
11 So with respect to the remaining issues that are
12 still in not full agreement with the staff, we've committed
13 to assess and act appropriately should any of these issues
14 be identified to have safety significance through the effort
15 that Fred is conducting.
16 We also have some degree of concern about an
17 unbounded criteria being applied to fires. We don't think
18 that would be in the best interest of the industry and we
19 think it could be detrimental to appropriate circuit design
20 for other aspects of nuclear plant safety.
21 DR. POWERS: I guess I'm still struggling with
22 what our database is on spurious operations of circuits and
23 fires. Everybody has found examples of spurious actuations.
24 Apparently, they did occur. But it's a really poor database
25 and since it's one point and it takes a lot of

1 reconstruction to go back and decide what spurious actions
2 actually occurred.
3 MR. GORMAN: Right.
4 DR. POWERS: But, I mean, fires happen a lot and
5 they happen a lot on electrical equipment and whatnot. So
6 what is the quality of our database on understanding the
7 kinds of things that can and do happen?
8 MR. GORMAN: I think the way Sandia has done --
9 has come up with different information than what the BWR
10 Owners Group has come up with. We went through all the
11 available testing and information that we could find and we
12 really didn't find information where people specifically
13 tested electrical circuits to see if they would cause
14 spurious operations.
15 There was some information out there that you
16 could look at and maybe draw some conclusions about voltages
17 on cable of adjacent conductors starting to approach each
18 other and those types of things, but the actual ability of a
19 fire to burn a circuit, to cause a piece of equipment to
20 spuriously operate with characteristics comparable to what
21 we had up there, we didn't find anything related to that.
22 And most of the cable testing that we came across
23 was testing that was done for flammability and smoke and
24 those types of things.
25 DR. POWERS: I keep wondering if -- I mean, the

1 military has to make their machines work in situations where
2 there are fires. I keep wondering if they don't have
3 information that they use in setting up their MIL spec
4 standards, that would be useful. They may not. It may be
5 that they take these smoke and fire things.
6 MR. GORMAN: That thought was kicked around in our
7 meetings and I guess we haven't been able to come up with
8 anything on their part.
9 DR. POWERS: The problem you get into when you
10 don't have a well constituted database is then you start
11 taking conservative positions. You say, well, I don't --
12 the fire is not very smart, it just does what fires do, and
13 I don't know what that is, so I just assume the worst.
14 MR. GORMAN: Right.
15 DR. POWERS: Maybe that's what you're speaking
16 about in the unboundedness.
17 MR. GORMAN: Right. And one of our concerns is if
18 you do assume the worst, the two criteria don't always work
19 in the same direction. You can have -- one that I
20 personally got involved with was for our fire in the control
21 room, which is a very difficult area.
22 The way that we've been trying to look at the fire
23 in the control room is that it's almost as though the
24 operating staff vacates the control room, but there's
25 another individual who is fire-proof, who is an operator

1 that's gone to the dark side and he tries to defeat
2 everything that they do.
3 And we were looking at it in that vein and we got
4 to the point where we were concerned about an uncontrolled
5 injection with our HPSI system in combination with a loss of
6 the high level trip and all this occurring in about a
7 three-minute period before we could get to the remote
8 shutdown panel, before we could get someplace and take an
9 action.
10 And in order for that event to occur, we were
11 talking about a series of hot shorts in a couple of
12 combinations. One would be a hot short that started the aux
13 oil pump that started the system up, followed by a hot short
14 that opened the steam injection valve, and then followed by
15 a hot short that opened the pump discharge valve, and that
16 same hot short also found a high level trip and if you
17 postulate those types of things, the only thing that you can
18 realistically do to mitigate the effects of that would be to
19 put a switch somewhere in the circuitry for HPSI, so that as
20 the operator leaves the control room, he runs and finds that
21 switch and he trips HPSI.
22 And we presented that fire solution to the
23 operating staff and they were not real happy because they
24 said you're going to put a switch in this system, that it's
25 going to fail, it's got a higher probability of failing

1 sometime during an everyday occurrence to seven days a week,
2 24 hours a day that we operate this plant, and we're not
3 going to let you do it.
4 So we came back and in that case, we had
5 discussions with the staff and they agreed that that was not
6 a reasonable thing to do. But if the criteria leads you
7 into those unbounded situations, then we're either going to
8 have to have a lot of discussions back and forth on the
9 individual eaches or run the risk of doing things like that.
10 So we believe our guidance document provides a
11 comprehensive criteria, design criteria for performing this,
12 and we think by having that comprehensive design criteria,
13 it's a start at getting everybody in the industry on board
14 in terms of the good practices for being able to perform one
15 of these safe shutdown analyses.
16 It doesn't answer all the questions that are being
17 kicked around in the last couple of years, but in the
18 document we sent in, we tried to provide our take on the
19 risk aspects of some of the things that we did not include,
20 and we've also sent in, in our cover letter, a statement
21 that if anybody finds anything of safety significance, we'll
22 assess it and act appropriately.
23 But we believe it's a real major step in terms of
24 putting together this criteria that we need. We think
25 people that employ it, based on other aspects of their

1 defense-in-depth program, are going to assure the ability to
2 achieve and maintain safe shutdown.
3 We think it's an approach consistent with the
4 regulation and we don't think doing it is going to
5 compromise other aspects of nuclear plant circuit design.
6 We think it provides a realistic criteria and we
7 think it can be implemented and we think it can be inspected
8 and we also believe that it reflects the consensus practices
9 of what people in the industry have used since we've been
10 doing these types of analyses.
11 There are some that have done more over the years
12 because of interactions, coaching on these issues, but, in
13 general, people believe that it's consistent with what they
14 believe the requirements are.
15 DR. POWERS: If I can come back to the SRV issue
16 and see if I understand things somewhat phenomenologically.
17 MR. GORMAN: Okay.
18 DR. POWERS: If I have an event where I have no
19 high pressure injection and I am trying to cool the plant
20 down using the SRVs and I've closed my main steam isolation
21 valve and I'm cooling down at the prescribed rate, which is
22 what?
23 MR. GORMAN: Less than 100 degrees an hour.
24 DR. POWERS: A 100 degrees Fahrenheit.
25 MR. GORMAN: Fahrenheit, yes.

1 DR. POWERS: Per hour. At what point will I have
2 a collapsed coolant level at the top of active core?
3 MR. GORMAN: At what point will you have a
4 collapsed coolant level at the top of active core? So from
5 the start of the scenario?
6 DR. POWERS: Yes. From the time I start
7 depressurizing or something like that.
8 MR. GORMAN: I think it's on the order of 1,587
9 seconds.
10 DR. POWERS: Okay. So like half-an-hour.
11 MR. GORMAN: Yes.
12 DR. POWERS: Approximately 1,587 seconds.
13 MR. GORMAN: And that's if the scram closed the
14 MSIVs and everything else you own had disappeared.
15 DR. POWERS: So like in a half an hour, I've got
16 it down. At that point, the operator will move to manually
17 activate the ADS system.
18 MR. GORMAN: He will manually activate the ADS
19 system, yes, per his EOPs.
20 DR. POWERS: And when that's activated, the actual
21 level of coolant will drop.
22 MR. GORMAN: That's correct. What happens is the
23 downcomer level drops and inside the core, you have a swell
24 that goes up maybe 15 or 16 feet.
25 DR. POWERS: Okay. It goes clear up into the --

1 MR. GORMAN: So it goes way up and then it will
2 come back down and it's coming back down as pressure is
3 being reduced with whatever number of SRVs you have open and
4 if you get the pressure down, depending on the number of
5 SRVs, quickly enough, you may never have that -- I'm talking
6 a void fraction at this point, not a collapsed level.
7 DR. POWERS: Yes, I understand.
8 MR. GORMAN: You will never get to the point where
9 the core itself is not covered with a water-steam mixture.
10 DR. POWERS: But I'm interested now that he is
11 following his EOPs.
12 MR. GORMAN: Yes.
13 DR. POWERS: And he's got an indication he's at or
14 very near the top of active fuel, so he activates the ADS.
15 You get this boil-up and then it collapsed down. How far
16 down does it go?
17 MR. GORMAN: How far down in the core region?
18 DR. POWERS: Yes.
19 MR. GORMAN: That's a function of the number of
20 SRVs that you use and the exact point at which you actuate
21 them. The Susquehanna analysis, we used six, and for ours,
22 we don't uncover the core. When you look at it from the
23 void fraction perspective, the core is not uncovered. It's
24 always a steam mixture.
25 I've seen other analysis where people use three

1 SRVs. They might uncover the core for -- the top portion of
2 the core for maybe two to three minutes. Peak clad
3 temperatures may go to 1,100, 1,150 degrees Fahrenheit, as
4 opposed to, say, 580 degrees when you're operating the power
5 plant.
6 DR. POWERS: That's what I needed to know.
7 MR. SIEBER: Any further questions?
8 MR. GORMAN: I'm all done, if there are no
9 questions.
10 MR. SIEBER: I think it's time that we can take a
11 break now.
12 DR. POWERS: I need to ask our expert on
13 probabilistic risk assessment here. We analyzed and have
14 found some substantial profit in looking at piping systems
15 and a probability. We're deciding whether to put attention,
16 from an inspection point of view, on the pipe, on the
17 valves, on the bends, things like that.
18 I mean, it's been very profitable and
19 illuminating. We find oftentimes you put your inspection
20 efforts in the wrong place.
21 Have people toyed with the idea of doing similar
22 kinds of things for circuit analysis?
23 DR. APOSTOLAKIS: Not that I know of.
24 DR. POWERS: I've been thinking of this diagram he
25 puts up there with the series of resistances in there and a

1 contactor and things like that and a dumb fire, not an
2 anthropomorphic fire, but a dumb fire.
3 You have a range of things that you can do and
4 then you go through and you say, well, where else should I
5 put all my effort on this thing, and maybe it simplifies the
6 analysis down -- some way to get out of the woods on this,
7 because I think the speaker makes a good point.
8 You can make these circuits so complicated that
9 they're unusable or unforgiving during normal operations,
10 which is the last thing you want to do in protecting against
11 rare events. This creates headaches for you.
12 DR. APOSTOLAKIS: I don't know if Nathan knows.
13 Has anybody done anything like that? I think this is
14 relatively new information. People are still digesting it.
15 I don't think that has been used for inspection purposes.
16 MR. SIU: This is Nathan Siu, Office of Research,
17 PRB. Actually, I think the next presentation is going to
18 get into how you use risk information and this is the NEI
19 presentation.
20 DR. POWERS: I'm talking about real risk analysis.
21 MR. SIU: Real risk analysis. Well, as you will
22 hear this afternoon, of course, we're developing tools and
23 data and we'll tell you about the extent that we've been
24 able to go.
25 DR. APOSTOLAKIS: But it is a new kind of area.

1 MR. SIU: That's right. That's right.

2 MR. SIEBER: Okay. I'd like to take a break to

3 10:50.

4 [Recess.]

5 MR. SIEBER: I'd like to request the meeting come

6 to order again. For the next presentation, we will hear

7 from NEI. Mr. Fred Emerson will discuss associated

8 circuits.

9 Go ahead.

10 MR. EMERSON: Thank you for asking me to come talk

11 to you again. Actually, I have one longer presentation and

12 a shorter presentation, which I will do back-to-back in this

13 time slot, but I won't run you overtime.

14 The first subject I will cover is the topic on the

15 agenda which is the associated circuits and what NEI is

16 doing to address them.

17 And the second topic, which is much shorter, will

18 -- I'll try to give an overview of the several methods that

19 are out there for resolving the issue and where NEI stands

20 on those three different methods and how they fit together.

21 The topics I will cover today are the status and

22 schedule of the NEI work, then what the NEI document itself

23 consists of, go through the method, and, at the request of

24 the staff, I'm going to spend a few minutes talking about

25 how the NEI method and the testing we're going to be doing

1 to address circuit failures addresses the issues that NRR
2 currently has on their plate with respect to circuit
3 analysis.
4 This slide shows the status and the schedule of
5 the things that remain as we finish our work on NEI-00-01.
6 The first step is the circuit failure characterization, and
7 I can best describe that by using the slide that Tom Gorman
8 had up there earlier, where he went through what the voltage
9 and current requirements are and the impedance in a circuit
10 that might be subjected to hot shorts.
11 We've been looking at that in more detail, looking
12 at the types of devices that are in the plant and what their
13 pickup voltage and current requirements are, what the
14 insulation resistance is between cables that have been --
15 where insulation has been badly damaged in a fire, and how
16 the combination of insulation resistance and the voltage and
17 pickup currents in the devices to be actuated match up with
18 each other.
19 Now, that is fairly complete right now. The only
20 thing that remains is some confirmatory testing that we have
21 planned for the next couple of months to address whether our
22 theories are correct and whether you get actually spurious
23 actuations when you do tests.
24 DR. POWERS: When you do tests, you want tests
25 that simulate well the kinds of fire events you're trying to

1 worry about, is that correct?

2 MR. EMERSON: That's correct.

3 DR. POWERS: And so how do you decide what an

4 appropriate test is?

5 MR. EMERSON: Well, you try to build in -- you try

6 to look at the variables which impact a device's ability to

7 actuate. You try to make the circuits as closely

8 approximate the types of circuits you see in a nuclear plant

9 as possible. You try to represent the fire conditions and

10 the variations thereof as accurately as possible.

11 You try to use the same types of cables and actual

12 circuits that you see in the plants.

13 DR. POWERS: I guess it's the simulation of the

14 fire that I'm most interested in. How do you decide? I

15 mean, how big does it have to be? It seems to me it makes a

16 difference whether a fire is here and very focused or spread

17 over some region bigger than I can reach.

18 MR. EMERSON: Well, to try to get a handle on

19 that, we've had a number of discussions with the staff to

20 get their inputs on what a reasonable fire size to postulate

21 is.

22 You can have very small fires, ranging from a

23 wastebasket fire, up to much larger fires involving gallons

24 and gallons of diesel oil, and we try to postulate the fires

25 that are the most representative of the fires we see in the

1 plant and yet have some leeway to vary those.

2 DR. POWERS: Well, if I took a frequency

3 distribution for the fires and said I wanted to hit the peak

4 in that frequency distribution, I'd probably have just

5 wastebasket fires, wouldn't I?

6 MR. EMERSON: Yes, but that doesn't mean you could

7 rule out bigger ones. So you have to have some, again,

8 leeway in there to test fires that are representative of

9 larger ones, even though they are somewhat rare, because you

10 certainly couldn't confine yourself to looking at only the

11 smallest fires.

12 So in that sense, what we're trying to do is to

13 vary the heat intensity of the fire and the test apparatus

14 to try to vary within a reasonable range what the fire sizes

15 that an actual set of electrical cables might see.

16 Continuing, as I say, the testing we expect to do

17 probably in early December of this year. We're at the stage

18 now where we have drafted a detailed test plan. The staff

19 has commented on it extensively. We have incorporated

20 almost all of their comments and they're going to be seeing

21 it again in a day or to for a last review before we complete

22 the contractual arrangements for the testing.

23 Separate from the testing and characterization

24 activity is determination of circuit failure probabilities.

25 That's something that I've presented to you in less detail

1 before and I will cover it in more detail now, how we
2 address the issue of making the -- addressing what the real
3 risk of a circuit failure is, one that results in core
4 damage.
5 We also need to build in PWR issues and we've
6 taken the BWR Owners Group document, which you've just heard
7 Tom Gorman describe, as a fairly thorough, comprehensive
8 basis for how analysis in the deterministic fashion can be
9 done.
10 And the only problem with making that into a
11 generic document is it doesn't reflect PWRs. So we are
12 taking steps to do that and we expect that to be finished in
13 November, also.
14 The screening methods, those are based on the
15 calculation of circuit failure probabilities and those --
16 I'm sorry. The circuit failure probabilities reflects the
17 completion of the testing. We are planning to comprise an
18 expert panel to try to turn the test results, plus earlier
19 testing information into probabilities of circuit failure.
20 DR. POWERS: Suppose your test came back that hot
21 shorts practically never occur. Spurious operation kinds of
22 events practically never occur, in the test. Would you just
23 reject that out of hand?
24 MR. EMERSON: I think you could certainly make an
25 argument that -- I don't think you could make an argument

1 that would exclude them, because we aren't going to be able
2 to do enough tests to show that something absolutely will
3 not happen.
4 DR. POWERS: What I'm driving it as it seems to me
5 that testing is good because it's controlled and whatnot and
6 you know everything that's going on about it, but there
7 surely must be some sort of a real database on fires and
8 things that occur. Maybe not so clearly applied conditions,
9 but give you an idea of what kinds of things are likely to
10 occur, and that's what you want for probabilities, is what
11 kinds of things are likely to occur, fires of various
12 intensities.
13 Is that database just totally unavailable?
14 MR. EMERSON: Well, I think probably Steve Nowlen
15 would be a good person to answer that question, based on the
16 work that Sandia did in looking at a body of testing that
17 had been done before which was somewhat applicable, but not
18 entirely, because the testing wasn't designed for the same
19 purpose that we are testing for.
20 A lot of those tests were cable flammability tests
21 and some, a few of them actually looked at what happens to
22 electrical circuits during fire conditions.
23 But the applicability of that is somewhat mixed.
24 We're trying to get closer to the specific phenomena in our
25 testing, so that we can -- we would like to be able to use

1 the data that previous tests have done that is applicable
2 and use the data that we have to draw some conclusions.
3 We probably won't get enough tests to make it
4 statistically provable as something is one way or another,
5 and that's why having an expert panel to address them is a
6 way to turn test information and data into probabilities
7 without having hundreds and hundreds of tests to use as data
8 points.
9 DR. POWERS: If you don't have hundreds and
10 hundreds of tests and a big database, how do you have
11 experts?
12 MR. EMERSON: You use experts, there are experts
13 on how to do fire PSAs and how to develop data into
14 probabilities. You have experts in how cables fail. You
15 have experts in how circuit analysis is done, and the
16 synergy -- we think a synergy of those experts will help us
17 come to those conclusions. All of those people exist.
18 DR. POWERS: My only point is that expertise is
19 only based on experimental data, unless you're asking the
20 expertise of solving integrals or something like that. You
21 have to have a database to be an expert. Otherwise, there
22 is no way to check the expert.
23 MR. EMERSON: That's true. Well, as I say, this
24 process is turning the testing results into probabilities.
25 The screening methods we expect to finish next month. We

1 have several -- we have a front-end screening method and a
2 back-end safety significant screening method, which I will
3 describe in more detail later.
4 Those will be done in November, with the exception
5 of the calculation of circuit failure probabilities, which
6 is one piece of the overall puzzle.
7 Then once the methods are all finished and
8 incorporated into the document, we'll run pilots and then we
9 expect to submit to the staff.
10 DR. APOSTOLAKIS: Now, the circuit failure
11 probabilities will depend on the geometry of the circuit,
12 won't they?
13 MR. EMERSON: That's certainly a large factor,
14 yes.
15 DR. APOSTOLAKIS: So perhaps instead of telling
16 the experts to give you failure probabilities, maybe they
17 can give you an accepted way of calculating the
18 probabilities.
19 MR. EMERSON: That's also a possibility.
20 DR. APOSTOLAKIS: But if you don't ask them, they
21 will never even think about it.
22 DR. POWERS: What promptly comes to mind is when
23 you say accepted, accepted by the experts.
24 DR. APOSTOLAKIS: By the experts, by the group,
25 taking into account the special features of a particular

1 circuit, they might tell you there is a way to do it rather
2 than giving you numbers.
3 MR. EMERSON: Numbers would be more useful, but if
4 --
5 DR. APOSTOLAKIS: Of course, but on the other
6 hand, they would be more vulnerable if they depend too much
7 on a specific configuration.
8 MR. EMERSON: The context into which this is all
9 being placed is a method that a utility can use to determine
10 how significant circuit failures are, or potential circuit
11 failures, and the easier we can make it for the utility to
12 apply this, if we can give him numbers rather than a method
13 to calculate the numbers, we simplify his work somewhat.
14 If we can't do that, then certainly we have to go
15 in the other direction.
16 DR. APOSTOLAKIS: Paraphrasing Einstein, you
17 should make it as easy as possible, but not easier.
18 MR. EMERSON: Okay. The next slide I would like
19 to put up is kind of an overview of the method itself, and
20 that you can find in the single-sheet handout.
21 This handout you can't possibly read, so I've
22 provided one of these, which also makes it a little easier.
23 I'm not going to spend a lot of time on any one area of
24 this. What I would just like to do is to indicate the flow
25 overall of how this method is intended to work.

1 You start with a potential circuit failure and you
2 would like to know how significant this thing is. We have a
3 generic screen up front, which is based on -- and, again,
4 I'll touch on each of these in more detail later, which is
5 based on consequences as a way to try to cut down the
6 population of potential things you need to look at further.
7 If the consequences are severe, we think that
8 presents the most severe challenge that a circuit panelist
9 needs to be concerned about. So that's where they would
10 start, and they would apply the up-front screening criteria
11 to determine whether -- how many of these potential circuit
12 failures were significant enough to analyze further and
13 which of them they could say were of low enough probability
14 that they could throw out.
15 Now, this block up here shows a starting point as
16 being NRC inspection findings or self-assessment question
17 responses. We expect that both licensees and staff,
18 depending on whether it's an inspection or self-assessment,
19 may identify areas where they're not sure that the issue has
20 been covered adequately at that plant.
21 So that would also feed into the overall -- to the
22 process, as well. So either self-identified or
23 NRC-identified issues.
24 What this thing does not show and a step that
25 we're considering is whether this should actually be up here

1 as a feed into the generic screening process.

2 The remaining blocks here, identifying systems and

3 equipment, systems and equipment needed for safe shutdown,

4 cables and so forth, you heard Tom Gorman talk about. These

5 blocks here are essentially the same things you heard Tom

6 talk about, with a couple of exceptions.

7 We believe that circuit failure characterization

8 will impact determining whether equipment needs to be looked

9 at further. Once you've gone through the more conventional

10 circuit analysis, then you're left with a couple of

11 alternatives. You have --

12 DR. APOSTOLAKIS: RSSP is what? What does that

13 stand for?

14 MR. EMERSON: Tom?

15 DR. POWERS: Required safe shutdown path.

16 MR. EMERSON: Thank you. Required safe shutdown

17 path. Once you have determined which equipment needs to

18 have something done to it, potentially, then you're left

19 with two alternatives. One is to carry out the mitigation

20 steps, which Tom indicated in his slide, which you can wrap

21 cable, you can provide better separation, you can reroute

22 cable, whatever.

23 But you can also -- the alternate path that this

24 method presents is you can do a safety-significance screen

25 using a series of PSA-related steps to determine how

1 significant these are.

2 DR. APOSTOLAKIS: Let me understand this now.

3 What's the driver of all this, Appendix R?

4 MR. EMERSON: The driver of all this -- you mean,

5 how you get into this?

6 DR. APOSTOLAKIS: Yes. All these issues. It says

7 Appendix R there, right?

8 MR. EMERSON: What's the driver for the issue, the

9 generic issue as a whole?

10 DR. APOSTOLAKIS: NRC inspection findings or

11 NEI-99-05 self-assessment. Are these Appendix R related?

12 MR. EMERSON: Yes.

13 DR. APOSTOLAKIS: Does Appendix R allow you to use

14 probabilities?

15 MR. EMERSON: Not at this time, no.

16 MR. WHITNEY: Leon Whitney, Plant Systems Branch.

17 Let me try and answer that question, because it's been 20

18 years with this.

19 The driver gets lost in --

20 DR. APOSTOLAKIS: But we're just getting --

21 MR. WHITNEY: Just getting started.

22 DR. APOSTOLAKIS: Renew all the licenses, we have

23 plenty of time.

24 MR. WHITNEY: Appendix R discusses associated

25 circuits in two places. One is Section 3G2 for redundant

1 trains and it says that associated circuits that are
2 identified should be given the same protection as the safe
3 shutdown circuits.
4 The industry indicates that through analyses, they
5 can indicate that things are not associated circuits because
6 they are not going to interfere in this way, and that's how
7 they get around that requirement there, I believe.
8 The other half is 3G3, alternative shutdown.
9 DR. APOSTOLAKIS: You must have read the appendix
10 many times.
11 MR. WHITNEY: Oh, many times. It is amplified in
12 Section 3L, where it talks to the fact that associated
13 circuits need to be shown not to prevent safe shutdown,
14 which is a little different construction than directing that
15 protection be given.
16 So if you're in alternative shutdown space, it's
17 more open to analytical approaches, but industry liberally
18 uses analytical approaches even in 3G2 and the staff has not
19 taken direct restrictions against that, as long as we
20 understand the analysis and are happy with it.
21 But the problem is, as we're going to talk about
22 tomorrow, it's how do you do this associated circuit
23 analysis to show that things are not going to interfere.
24 That's where we become a cropper.
25 The genesis is in Appendix R in two places.

1 DR. POWERS: When you use Appendix -- just a
2 clarification here, George. When you use Appendix R, do you
3 distinguish between it and the branch technical position?
4 Not all plants are covered by Appendix R.
5 MR. WHITNEY: True. We never inspect against --
6 speaking from the inspection point of view, we don't inspect
7 against Appendix R for a post-'79 plant. We look at the
8 licensing basis.
9 A lot of the licensing bases, either directly or
10 indirectly, appeal to the Appendix R verbiage in them, but
11 we do uphold whatever is in the licensing basis.
12 DR. APOSTOLAKIS: Well, the thing that confuses me
13 a little bit, it's a question mark, in my mind. I mean, if
14 I take a deterministic or a traditional piece of regulation,
15 to what extent can I compliment it by considering PRA
16 considerations?
17 MR. WHITNEY: Well, we are embarked here with a
18 voluntary industry effort to basically be risk-informed in
19 this endeavor.
20 DR. APOSTOLAKIS: Are you risk-informing Appendix
21 R then indirectly?
22 MR. WHITNEY: Well, NEI is ostensibly providing,
23 at the end of their process, a risk-informed way of doing
24 circuit analysis. Now, it's really fire testing supported,
25 would be probably a more clear way of saying that, plus any

1 other methodologies that they can find.

2 But they are using fire tests to delve into the

3 probabilities of the circuit faults that are under

4 discussion. So to that extent, it's more -- it's certainly

5 not a deterministic approach that they're using.

6 The BWR Owners Group, on the other hand, used a

7 very deterministic approach that they discussed with you

8 earlier.

9 MR. EMERSON: George, to further answer your

10 question, this effort had its genesis back a couple of years

11 ago when we were having a lot of discussion with the staff

12 over interpretations of Appendix R regarding a couple of

13 specific issues.

14 One was multiple spurious actuations and the other

15 was Information Notice 92-18 considerations. And we went

16 back and forth with the staff and we're not making any

17 headway one way or the other.

18 So a workshop was convened back in July of 1998,

19 where this issue was explored. NEI proposed that rather

20 than continuing to argue in licensing space over whether the

21 licensees had done things properly or not, we would put

22 together a group that would develop a risk-informed method

23 for determining how significant these issues really were,

24 with the idea being if they're significant, we'll do

25 something about them, and if they're not significant, then

1 it's much less important to.

2 DR. APOSTOLAKIS: But the question is whether, by

3 using risk information, you are interpreting certain terms

4 in the appendix in a particular way.

5 I mean, when it says protect, when it says make

6 sure that this doesn't happen, then you are giving it a

7 probabilistic interpretation. And has anybody looked into

8 that, what it exactly means, or is it a straightforward

9 thing that I haven't thought about?

10 Maybe the staff should answer those questions at

11 some point.

12 MR. WEISS: This is Eric Weiss. I'm the Chief of

13 the Fire Protection Section. I'm relatively new to this

14 job, but one thing that impresses me is that sometimes there

15 are differences of opinion about the meaning of Appendix R

16 in certain specific applications.

17 And I think sometimes these arguments can become

18 very arcane and it would be better if we had a technical

19 basis for concluding what the proper interpretation of

20 Appendix R is than if we did not have a technical basis.

21 In other words, I think what Fred Emerson alluded

22 to earlier was that if one wanted to, one could reduce this

23 to a legal argument and arguing what he calls licensing

24 space.

25 But I'm not sure that that's the most productive

1 way to go forward. The industry volunteered to take on the
2 job of providing a sound technical basis for these issues
3 when they become unclear, and I'm talking specifically about
4 circuit analysis.
5 There are certain issues in circuit analysis where
6 things are unclear and they're going to help us in that
7 regard by doing these tests and applying these techniques
8 and help us bring these issues to closure.
9 I mean, I don't think a reasonable man would say
10 that simply because one could possibly read Appendix R in
11 this way and either we're going to make you do it, even
12 though it makes no sense from a technical point of view.
13 Conversely, if something is safety-significant, we
14 don't want to put our blinders on and ignore that. We
15 certainly want to use the regulations we have in the most
16 intelligent way possible.
17 DR. APOSTOLAKIS: Well, the question would be how
18 do you evaluate safety significance and if you decide to go
19 the PRA way, what is a safety-significant issue?
20 MR. WHITNEY: I don't want to speak for industry,
21 but we are currently embarked on deriving frequency of
22 occurrence numbers, without regard to completing the PRA
23 risk evaluation consequence.
24 For example, to answer your question directly on
25 how we are, quote, interpreting the rule with risk, I don't

1 believe that's the case, but in 3G2, where it says protect,
2 it says for those things -- those associated circuits that
3 can cause a problem, and I'm going to sound like the
4 President of the United States, it depends how you define
5 cause.
6 I believe in industry's term, if they can show,
7 down to the ten-to-the-minus-six probability frequency of
8 occurrence level, that this isn't going to be caused, then I
9 think they're complete at that point.
10 And I just wanted to say that and see what
11 industry's reaction of that characterization of their work
12 is.
13 MR. EMERSON: That's basically it. You start off
14 with a characterization of the frequency of fires and then
15 you add all of the factors that go into determining whether
16 a fire results in core damage frequency or not.
17 And at some point, those parameters either do or
18 do not cross some threshold when you multiply them all
19 together that you would use as a criterion.
20 DR. POWERS: It seems to me that the difficulty
21 that you get into here is that you have a distribution of
22 fires, and most of them are -- well, I think wastebasket
23 fires don't count because they're not reportable, but
24 something bigger than wastebasket, up to normal.
25 And it's not just a multiplication of all the

1 factors. It's a multiplication of all the factors, times
2 the frequency of a particular fire, summed over all the
3 frequencies of fires, that that's what should be compared
4 against the ten-to-the-minus-six, not the individual event.
5 Isn't it?
6 MR. EMERSON: I'm not sure I quite followed you.
7 DR. APOSTOLAKIS: You see, you're taking point
8 estimates and multiplying them, comparing them to the
9 threshold, and these point estimates really have uncertainty
10 about them.
11 MR. EMERSON: They're distributions, right.
12 DR. APOSTOLAKIS: So what role does that play? I
13 mean, something that you think is ten-to-the-minus-six may,
14 in fact, be five-ten-to-the-minus-five. Would it change my
15 conclusion that this thing did not cause anything?
16 See, this is a new round now, because you are not
17 really proposing any changes in the licensing basis, not yet
18 anyway.
19 So Regulatory Guide 1.174 doesn't really apply.
20 So how do we screen things out? If you look at PRA and the
21 minimal cut sets, the screening criteria are very strict.
22 If you expect a core damage frequency of
23 ten-to-the-minus-five, I believe you are instructed to go
24 down three or four orders of magnitude to start screening
25 out minimal cut sets, and that's the whole cut set.

1 So you're talking about ten-to-the-minus-eight or
2 something. And yet here we're using a ten-to-the-minus-six,
3 much worse, is on a point estimate basis.
4 MR. EMERSON: I don't think we have any intention
5 of disregarding the distributions. I mean, we're not just
6 going to take a single point estimate, because, as you point
7 out, there is a distribution associated with that. So I
8 didn't want to oversimplify it too much. But each of the --
9 DR. APOSTOLAKIS: I haven't seen it yet, by the
10 way. I mean, in general, if you work with screening
11 criteria, you ask the analyst to go and develop
12 distributions, you're defeating the purpose of screening.
13 Somehow you have to give guidance how to get those
14 upper bounds and do the job. But I guess it's not clear to
15 me that it's straightforward to take a traditional
16 deterministic, so to speak, regulation and just use PSA to
17 support certain arguments.
18 I mean, there are certain questions that come up.
19 Anyway, we'll wait and see if Robert can comment on that,
20 but that's certainly something that needs some thinking.
21 MR. EMERSON: You mentioned Reg Guide 1.174 and it
22 was our intent to try to make this method at least
23 consistent with that, even if it didn't directly apply.
24 DR. APOSTOLAKIS: Yes, 1.174 deals with proposed
25 changes in the licensing basis and gives you criteria for

1 those, but it does not really tell you anything about
2 screening out things when you don't change the licensing
3 basis. And so far, you are not changing it. All you are
4 doing is you are using analysis to show that certain
5 questions that the staff thinks are issues are not issues.
6 DR. POWERS: That doesn't strike me as that's a
7 great leap there. It doesn't seem to me that there is an
8 enormous conceptual leap from saying, okay, in the licensing
9 basis, I've done some things, I can't absolutely
10 quantitatively prove beyond the shadow of a doubt that this
11 has eliminated this from consideration, but I can come in
12 and make an argument that says that if I'm wrong, the delta
13 CDF is very small here.
14 That doesn't sound like an enormous leap of
15 consciousness from the explicit wording of 1.174.
16 DR. APOSTOLAKIS: But that's not what they're
17 doing.
18 DR. POWERS: I think that's what it is. He's
19 coming in here and saying okay, I have these capabilities in
20 my plan. I can't show absolutely and positively that they
21 satisfy the regulatory requirements or the standard review
22 plans and whatnot to every dotted I and crossed T, because
23 reasonable men can argue over these various things, but I
24 can screen it out from consideration by saying that even if
25 I'm wrong, it's not a big deal.

1 DR. APOSTOLAKIS: I guess the question is what's a
2 big deal.
3 DR. POWERS: Well, he's going to define it and if
4 he's going to say ten-to-the-minus-six -- but, don't worry,
5 Fred, we'll let you get on with your presentation
6 eventually.
7 You can look at the 1.174 and say -- and all the
8 associated discussion around it and say, well, what were
9 these people thinking was an inconsequential change in the
10 CDF probability, and maybe they even go further and say LERF
11 probability, but that's a little harder step to take.
12 DR. APOSTOLAKIS: Let me switch the argument
13 around. 1.174 asks you to enter the abscissa with your
14 current CDF. Some plants have a CDF that's very low,
15 five-ten-to-the-minus-six, others are ten-to-the-minus-four
16 neighborhood.
17 And you are not penalized really because you have
18 a ten-to-the-minus-four or, say, eight-ten-to-the-minus-five
19 core damage frequency, because the delta CDF is the same and
20 so on.
21 So what if I have a plant that says, okay, my
22 current CDF is six-ten-to-the-minus-five and I will use, as
23 a screening criterion, five-ten-to-the-minus-five, which is
24 five times, or three-ten-to-the-minus-five, which is three
25 times the allowed delta CDF in 1.174.

1 So following Dana's argument, if I'm wrong, my
2 baseline CDF goes from five to eight. There is nothing to
3 prevent me from doing that, because I'm not changing the
4 licensing basis. The ten-to-the-minus-six or five doesn't
5 apply to me anymore. This is a new CDF.
6 DR. POWERS: What blocks you is the staff probably
7 won't let you do that. You're taking an extreme there.
8 He's taking a much lower value here for the screening
9 criteria.
10 DR. APOSTOLAKIS: If I am to spend $40 million to
11 make changes to the plant and I realize that I have this
12 loophole, I'll do it, because, you see, you don't question
13 my baseline CDF. So I'll tell you, look, I was wrong, it's
14 not three-ten-to-the-minus-five, it's
15 eight-ten-to-the-minus-five, but everything is cozy. Right?
16 Because I haven't changed the licensing basis, so I'm not
17 constrained by 1.174.
18 That's beautiful, because that gives them a hell
19 of a lot of leeway here. I mean, it's conceivable that this
20 could happen.
21 DR. POWERS: I think it's quite the contrary. I
22 think it's totally inconceivable. We're dealing with a very
23 responsible industry, George. These guys live and die based
24 on safety. They're not going to go taking chances with a
25 plant based on that.

1 DR. APOSTOLAKIS: But three-ten-to-the-minus-five,
2 that's pretty low, and I'm still below the goal. What else
3 do you want? You gave me a goal and I'm below it.
4 DR. POWERS: But that's not what the speaker is
5 going to talk about. This is the Apostolakis construct.
6 DR. APOSTOLAKIS: Well, I'm just telling you,
7 these are the things you're going to get if you add PSA
8 considerations into deterministic rules without having some
9 sort of guidance in advance, just as we developed 1.174.
10 This gentleman here wants to say something.
11 MR. NAJAFI: I just want to add a couple of things
12 in here. Bijan Nejafi. I'm here sitting in for EPRI. I
13 actually work for SAIC, but I'm sitting here for EPRI.
14 A couple of questions came up here. One of them
15 is that I think in comparison with 1.174, this, in fact,
16 does look, in a way, at a change, because our starting point
17 is that the existing domain of the Appendix R required
18 looking at a certain number of circuits.
19 Here, what we're postulating, saying let's say if
20 there were certain circuits we didn't look at which we were
21 supposed to look at, let's say, we want to determine the
22 safety significance of what we didn't look at, which is the
23 change, what we didn't look at, and determine if there is
24 some safety significance, maybe we should do something about
25 it; the ones that are not, we don't need to do anything

1 about it.

2 So that's the delta. We enter the system with

3 that delta. The question about the what do we screen, when

4 do we screen and how do we screen, it's absolutely very

5 critical.

6 There is embedded in these screenings, you see

7 here, one through six, at the beginning, there was

8 established criteria to do that. It does not look at

9 individual fires to screen and it's a two or

10 three-dimensional screen that says everything you get rid

11 of, like one of your cut sets, be careful to look at its

12 effect as a total.

13 It does not go through a cut set review and set it

14 three or four orders of magnitude below, because it's a

15 different common cause. It's not a random event combination

16 to go that route.

17 But there is an alternative route to ensure that you have

18 not set your screen too low and miss things that could be

19 significant.

20 DR. APOSTOLAKIS: Too low or too high.

21 MR. NAJAFI: Too low or too high, you have not set

22 it too high. So basically it looks -- every time it looks

23 at it, it says if this fire wasn't significant, check it for

24 across the areas, check it for the total and all that kind

25 of stuff.

1 It's a more complicated screen than it is a single
2 number throw-away fire scenario.
3 DR. APOSTOLAKIS: I still think that the main
4 thing that's happening here is a reevaluation of the
5 baseline CDF. I don't think we have any guidance as to how
6 much that is allowed to change without something happening.
7 Just because somebody didn't tell me it's
8 possible, they had six-ten-to-the-minus-six, and came
9 directly with five-ten-to-the-minus-five, why should I
10 penalize somebody else?
11 MR. NAJAFI: I guess you're raising the question
12 that what's unacceptable acceptance criteria, what is the
13 right acceptance criteria to use.
14 DR. APOSTOLAKIS: It comes down to that.
15 MR. NAJAFI: When we talk this afternoon about
16 805, that's the same challenge. That comes from the fact
17 that 1.174 establishes an acceptance criteria for risk based
18 on CDF and LERF.
19 DR. APOSTOLAKIS: Acceptance criteria changes.
20 MR. NAJAFI: Changes the risk. There is not a
21 predefined equivalent of that for fire alone.
22 DR. APOSTOLAKIS: Why should there be?
23 MR. NAJAFI: Well, the question is --
24 DR. APOSTOLAKIS: There isn't anything for
25 earthquakes, there isn't anything for LOCAs.

1 MR. NAJAFI: I'm saying the question we're facing,
2 that should we use the total; therefore, you calculate total
3 to put it in that.
4 DR. APOSTOLAKIS: There is no allocation.
5 MR. NAJAFI: There is no allocation.
6 DR. APOSTOLAKIS: Sure, there isn't.
7 MR. EMERSON: The reason we got into this was the
8 staff always requests people to look into things and make
9 fixes based on the fact that things could happen in Appendix
10 R space.
11 Industry people would tell you, oh, that's so
12 unlikely that I shouldn't ever have to worry about that. So
13 you have qualitative arguments on both sides that something
14 was either possible on one side or very unlikely on the
15 other.
16 So what we're trying to do is to try to home in on
17 is it unlikely and if it is unlikely, what's the impact on
18 the plant.
19 DR. APOSTOLAKIS: I understand that.
20 MR. SIEBER: When you're all done and have done
21 the analysis, what do you anticipate the next step would be?
22 A rulemaking to change Appendix R to make it risk-informed?
23 MR. EMERSON: No.
24 MR. SIEBER: Or a bunch of exemptions?
25 MR. EMERSON: This is intended --

1 MR. SIEBER: Or are you just not going to do
2 stuff?
3 MR. EMERSON: This is intended for an individual
4 licensee to use to look at his plant, see the types of
5 circuit failure analysis he has either done at his plant or
6 hasn't done at his plant, and if there is a perceived gap
7 between what he did and what he should have done, allows him
8 -- gives him a tool to decide what action he should take.
9 MR. SIEBER: Yes.
10 MR. EMERSON: He should either fix something or it
11 doesn't make sense to fix it because it's --
12 DR. APOSTOLAKIS: If I wanted to risk-inform
13 Appendix R, what would I do different?
14 MR. SIEBER: You'd have to change the words to
15 allow that. Otherwise, Appendix R right now is very
16 deterministic.
17 DR. APOSTOLAKIS: But if I accept --
18 MR. SIEBER: If you accept that, then you change
19 the wording.
20 DR. APOSTOLAKIS: The changes are minimal. I
21 mean, you are risk-informing the appendix, it looks like.
22 MR. SIEBER: Right.
23 MR. EMERSON: Once you get through with your
24 analysis, you end up with -- you can drop out of the
25 screening process at any point if you've decided that the

1 cost of fixing the problem is less than the cost of further
2 analysis, you can drop out at any point and then develop a
3 resolution strategy, or you can continue through the
4 screening process and try to, through the application of
5 successively less conservative steps, defendable, but less
6 conservative, get to the point where you can actually get
7 the number down to something below the threshold.
8 If you -- I think one important thing to remember
9 here is that you don't just do the PSA steps in isolation.
10 And just like Reg Guide 1.174 does it, it tells you that you
11 have to consider safety margins and defense-in-depth.
12 So if you were to end up with a solution, say,
13 that removed one whole element of defense-in-depth, where
14 you said that was okay from your PSA analysis, to take an
15 extreme case, we would say, wait a minute, you can't really
16 do that, you have to apply a level of reality to what your
17 PSA analysis told you.
18 DR. POWERS: When you talk about defense-in-depth
19 in this context, are you distinguishing it from the concept
20 of defense-in-depth that's delineated in Appendix R?
21 MR. EMERSON: That's the defense-in-depth concept,
22 prevention, mitigation, safe shutdown, the three
23 defense-in-depth elements.
24 DR. POWERS: I think in Appendix R, it lines out
25 the defense-in-depth elements as prevention, suppression,

1 detection and suppression, and protection of equipment from
2 damage.
3 MR. EMERSON: Yes, I agree with that.
4 DR. POWERS: But in 1.174, rather than calling it
5 defense-in-depth, they call it a defense-in-depth philosophy
6 and there they are really talking about barriers to
7 radioactivity release.
8 So I'm wondering, when you speak of
9 defense-in-depth and comparing your decisions against
10 defense-in-depth, are you using the Appendix R definition or
11 are you using this philosophy that's in 1.174, or both?
12 MR. EMERSON: Mostly the Appendix R version of
13 defense-in-depth, since that's the way plants were designed
14 to respond to fires.
15 DR. POWERS: You could use the other and it's far
16 enough removed that I think it becomes challenging, whereas
17 by using the Appendix R, then I think you're closer to the
18 heart here.
19 MR. EMERSON: And once you're all done --
20 DR. APOSTOLAKIS: So you should stay instead of
21 DID considerations, DID philosophy.
22 DR. POWERS: No, no, no. DID. It's not doing the
23 philosophy. He's doing DID.
24 DR. APOSTOLAKIS: I don't know how he can do that.
25 There isn't such a thing.

1 DR. POWERS: The only place that defense-in-depth
2 is defined at all is in Appendix R and it's defined very
3 explicitly in Appendix R.
4 DR. APOSTOLAKIS: Yes. It says look at ignition
5 and prevention --
6 DR. POWERS: It says prevention, detection and
7 suppression, and protection of equipment against damage.
8 DR. APOSTOLAKIS: Within each one of those, I have
9 a philosophy, because anything I do affects prevention.
10 DR. POWERS: You have a philosophy. I don't think
11 Appendix R has one.
12 MR. EMERSON: The idea here is that if you were to
13 somehow conclude that you didn't need to provide any safe
14 shutdown in a given area --
15 DR. APOSTOLAKIS: I understand.
16 MR. EMERSON: Then that obviously is something you
17 need to think about a little harder before you screen
18 something out. And when you're all done, you may or may not
19 -- you've either gotten to the threshold or you haven't, and
20 if you are still above ten-to-the-minus-six, then you would
21 want to do something about it, because you would deem that
22 according to the criteria that you had set up,
23 safety-significant.
24 DR. APOSTOLAKIS: Now, the resolution strategies
25 will be evaluated in a risk context?

1 MR. EMERSON: I'm sorry. Which strategies?

2 DR. APOSTOLAKIS: The box, develop resolution

3 strategies.

4 MR. EMERSON: That's what the whole purpose of

5 this --

6 DR. APOSTOLAKIS: It's on the bottom.

7 MR. EMERSON: We started out up here looking at

8 resolution alternatives and the idea is that we have a

9 potential -- say we have two valves in series that, as Tom

10 indicated, need to be -- that would seem to need protection

11 after you've gone through this whole analysis.

12 Your next step is either to do something to fix

13 those two valves through some type of deterministic fix or

14 determine how safety-significant it is.

15 So this is the process by which you turn looking

16 at alternatives into a detailed strategy once you've gotten

17 done with this. You'll determine does it make more sense to

18 wrap the cable, does it make more sense to --

19 DR. APOSTOLAKIS: But will there be a risk

20 analysis of that? If I wrap the cable, what happens?

21 Because there may be negative impacts, as well.

22 MR. EMERSON: That goes back into the realm of how

23 the engineering decisions are made to do -- for the various

24 types of resolution strategies.

25 DR. APOSTOLAKIS: Most likely, I will revert back

1 to the deterministic calculation.

2 MR. EMERSON: That's correct. The way you fix it

3 is decide it deterministically, once you've determined how

4 significant it is.

5 DR. APOSTOLAKIS: Which, again, doesn't give me a

6 very warm feeling. I mean, if you decide to enter PSA, you

7 might as well go all the way.

8 Anyway, let's go on. Let's go on.

9 MR. EMERSON: Okay. Now, the next two or three

10 slides I'm not going to spend much time on. I would just

11 like to indicate what they are.

12 I indicated that we started off using the BWR

13 Owners Group guidance document as a template for how

14 NEI-00-01 is laid out. The appearance of the document is

15 very similar. The appendices look very similar. But there

16 will be a number of changes that will provide a strong

17 distinction between the two documents.

18 The changes are that this will apply to all

19 plants, because it will reflect PWR systems. It will

20 address some of the NRC's technical issues that the BWR

21 Owners Group guidance document doesn't address directly.

22 DR. APOSTOLAKIS: What does it say? Let me read

23 it right here. You're blocking. Changes in progress to

24 provide seamless integration. That's pretty ambitious,

25 Fred.

1 MR. EMERSON: Well, we're going to try. By
2 seamless, I mean you don't have to jump from one document to
3 the other. You have something laid out that allows you to
4 flow from --
5 DR. APOSTOLAKIS: If I were a negative kind of
6 person, I would say this is an arbitrary integration.
7 MR. EMERSON: Well, it's arbitrary because we're
8 doing it.
9 DR. APOSTOLAKIS: I mean, I'm jumping from PSA to
10 the deterministic world anytime I please.
11 DR. POWERS: If I was going to compliment Fred on
12 what he's put together, I think that he's been very
13 successful in doing just what he set out to do, where
14 seamless is defined as not having to jump from one document
15 to the other. I think you've done a pretty good job on that
16 chore.
17 MR. EMERSON: The whole idea is to make this as
18 user-friendly as possible.
19 DR. POWERS: I would say -- I mean, you're not
20 done yet, but you're --
21 MR. EMERSON: That's why we have pilots, to see
22 whether we succeeded in that regard.
23 DR. POWERS: That seems to be one of the really
24 good features about what you've put together, is just
25 exactly that line right there.

1 MR. EMERSON: How successful we are depends on how
2 well the user can actually apply this once it gets it.
3 DR. POWERS: That's right.
4 DR. APOSTOLAKIS: And convince the NRC staff.
5 MR. EMERSON: Yes.
6 DR. APOSTOLAKIS: Because the user may be very
7 happy. If the staff is not convinced, then it's not
8 seamless.
9 Anyway, okay, that shows me that you're really
10 shooting very high.
11 MR. EMERSON: This is an important issue to get
12 resolved, so we have to shoot very high on behalf of the
13 licensees who are dealing with it.
14 Some of the other changes. Tom discussed multiple
15 high impedance faults. It's our intent to deal with that.
16 There is an appendix related to manual actions. We're going
17 to probably revise that somewhat based on the conclusions
18 from our testing and our circuit characterization.
19 Appendix G, we'll be revising that to outline in
20 more detail the up-front screening method that allows you to
21 decide up front whether to get into this at all or not.
22 And continuing, we'll have a new appendix which
23 describes the circuit failures of concern, and that's
24 basically going to be the result of our characterization and
25 our testing.

1 It will provide the results of that and what we
2 can conclude from the testing relative to the types of
3 failures that make sense.
4 When I say types of failures that make sense, I'm
5 thinking of questions like interactions between conductors
6 in two adjacent cables versus conductors in the same cable,
7 multi-conductor interactions versus what we call
8 cable-to-cable interactions or how far apart do the cables
9 have to be before you can rule out interactions.
10 Those are the kinds of circuit failures of concern
11 we're going to try to deal with.
12 And the last change will be the whole method
13 that's laid out in this six-step screening process, which
14 I'll get to in just a minute.
15 The next slide talks about how this is supposed to
16 be used, at least the way we see it now.
17 The up-front process, as I indicated earlier, it's
18 intended to be used if a plant has known issues that they're
19 dealing with, either self-identified or identified by the
20 staff. If they haven't, if they have concluded somehow that
21 they haven't fully addressed circuit analysis issues to the
22 degree that they think is appropriate, and it allows the
23 plant to focus on the risk-significant actuations to whittle
24 down this unbounded analysis that Tom referred to to
25 something that they can actually get their arms around and

1 actually spend their efforts focusing on significant things,
2 rather than a large population of things that isn't and
3 might detract from addressing the real issues.
4 DR. POWERS: It seems to me that in this, you're
5 getting down to a plausibility argument between one group
6 and another. That you have, on the one hand, people saying,
7 gee, I find fires difficult to predict and their effects on
8 circuits and so I'll be exhaustive.
9 You have, on the other side, no, I can plausibly
10 argue that some actuations are not likely.
11 And you just don't have a real strong database to
12 support that opinion and that seems like a challenging thing
13 to do.
14 MR. EMERSON: That's the reason we're actually
15 going to do testing, is to try to improve the size of the
16 database.
17 DR. POWERS: You did talk about that.
18 MR. EMERSON: Because one could argue about
19 phenomena all day.
20 DR. POWERS: For a long time and in the absence of
21 experimental data.
22 MR. EMERSON: Right. Or you could argue how valid
23 certain experiments were or weren't or what they proved or
24 didn't prove, and that demonstrates the need to design tests
25 that actually go to the heart of what you're trying to

1 address with this issue.

2 DR. POWERS: You talked about sharing this

3 experimental plan with the staff and I have enormous respect

4 for the staff, but they represent a fairly narrow spectrum

5 of the community that worries about experiments of this

6 type. Have you tried to share your experimental plans to a

7 larger community, fire protection professionals in general

8 or heat transfer or electrical circuit people, IEEE people

9 and things like that?

10 MR. EMERSON: We've got several groups we try to

11 get buy-in from. One is it starts with our circuit failures

12 issue task force, which is comprised of PSA experts, people

13 who understand how cables fail and how they work in plants,

14 people who know how to do safe shutdown analysis in the

15 plant, everyone who I think could possibly weigh in from an

16 industry standpoint at a technical level, we get their

17 buy-in.

18 Beyond that, we have -- we're certainly talking to

19 the staff, both NRR and the Office of Research and their

20 contractors, and we've had a lot of good discussion with

21 them to make sure that both the regulatory and the research

22 needs are addressed with this, because it doesn't do us any

23 good to do testing if, after the fact, the staff says, well,

24 we don't buy your results because you didn't do X.

25 Then we just wasted a lot of money for nothing.

1 So getting that buy-in up front makes an awful lot of sense.
2 As far as a broader community, I kind of depend on
3 the staff to decide, from a regulatory standpoint, how broad
4 the community needs to be, but we certainly try, on the
5 industry side, to expand the number of people -- we try to
6 strike a balance between letting everybody look at it and
7 never getting it done, to letting the right people look at
8 it, who represent the types of expertise you need to have
9 represented and getting those comments, in put.
10 DR. POWERS: You and I certainly both attended a
11 conference that the IAEA hosted and we saw active interest
12 in these fire phenomena in the world and I think we're both
13 aware that the French are investing heavily in experimental
14 investigations of fires of various types.
15 I wonder if they should -- if we could get any of
16 the input from them on what kind of tests really are
17 meaningful.
18 MR. EMERSON: I see. You're looking at the
19 international community.
20 DR. POWERS: They're obvious ones to go to. You
21 attended and were a major speaker at that conference, so you
22 know them better than I do, I think, and whether they'd be
23 helpful or not.
24 MR. EMERSON: My sense is that some of the
25 international folks who are doing this type of work are

1 interested in somewhat different goals than we are. They're
2 not quite so concerned about the regulatory issue of how
3 circuits fail.
4 They're more interested in how cables burn and
5 whether they propagate or how rapidly they propagate.
6 DR. POWERS: But isn't that what you're trying to
7 find here in the experiments?
8 MR. EMERSON: We're not so interested in how the
9 insulation behaves in terms of how rapidly it burns and
10 propagates. We're interested in what happens to the
11 conductors after the insulation is damaged, and those are
12 goals that are not quite the same as -- at least in my
13 perception -- what the international community is looking
14 at.
15 I'm not saying that their input wouldn't be valid,
16 but at some point, we'd just have to say we have to cut the
17 population of reviewers down.
18 DR. APOSTOLAKIS: So are we the only ones who
19 worry about circuits?
20 MR. EMERSON: I won't say we're the only ones,
21 because other -- say, other countries are interested in what
22 we're doing, but I haven't seen contacts from the French and
23 the Germans, who I have been in contact with, that this is
24 really a high priority for them.
25 They're, I think, maybe willing to let us do what

1 we're going to do and then use our results and then perhaps
2 stimulate --
3 DR. POWERS: Clever them.
4 MR. EMERSON: We've taken advantage of some of
5 their work and maybe they can take advantage of some of
6 ours.
7 This is what we intended to use it for. We're not
8 intending to use it to go back for licensees to reexamine
9 their whole body of circuit analysis. That's not the
10 intent, because they've put in a lot of effort and a great
11 many millions of dollars to do circuit analysis to address
12 Appendix R or the branch technical position, as you
13 indicated earlier.
14 If a plant's method of addressing circuit analysis
15 issues has been accepted by the staff, we're not going to
16 tell, and I mean explicitly, how they do things, then
17 there's not much point -- not much gain for a licensee to go
18 back and use this.
19 So if you're done, you're done. You don't have to
20 go back and reinvent the wheel.
21 Let me go through some of the steps of what our
22 method is intended to address. I mentioned
23 characterization, and that's basically of circuit failure
24 modes; how do circuits fail in the event of fires.
25 The concepts we're trying to get at are the

1 meshing point between what the insulation resistance -- what
2 happens to the insulation resistance between conductors and
3 how do you compare that to the device actuation thresholds,
4 as Tom talked about earlier.
5 The idea is you may have a drastic loss of
6 insulation resistance and a damaged cable, but if it doesn't
7 get to the point where the device will actuate, then you
8 have still some degree of protection.
9 You don't automatically have to assume that a hot
10 short turns into a spurious actuation. So we're trying to
11 get a little closer to how the insulation resistance does
12 match up with the thresholds.
13 And if I could just jump ahead to the testing for
14 a minute, what we're trying to do -- you could -- in talking
15 about insulation resistance, you could design tests that do
16 nothing but measure insulation resistance and you could
17 design tests that do nothing but test actual devices as to
18 whether they actuate or not.
19 And what we're going to try to do is to do a mix
20 of the two, so that you can determine whether devices
21 actually actuate and then correlate that with the insulation
22 resistance values that you get, and this is going to be a
23 fairly heavily instrumented -- each test is going to be
24 fairly heavily instrumented, so we can test how some of the
25 adjacent conductors, both within and without the cable,

1 behave when the insulation is damaged.

2 So the combination of the two is the best way to

3 -- so we're not just, as you said earlier, showing that a

4 bumblebee can't fly by measuring only insulation resistance.

5 Tom talked about the Owners Group position on

6 multiple high impedance faults and while that's a separate

7 -- it's a separate part of the characterization activity,

8 we've looked at a couple of the -- EPRI's contractors have

9 looked in some depth at the MHIF issue and both have

10 concluded that it doesn't make much sense for the licensees

11 to continue spending a lot of resources in this area, and

12 we're going through a peer review of those results so far.

13 It has to do with what they call the X-over-R

14 ratios at the plant. There's a body of thought that says

15 based on what you actually see at the plant, the X-over-R

16 ratio suggests that you will not have a problem. There is

17 another body of thought that says depending on how the

18 systems are grounded in the plant says a lot about whether

19 you can have these types of faults or not and those were --

20 we're getting those positions developed to a point where we

21 can say yes or no, this is an issue that the plant should

22 have to continue to spend a lot of work in configuration

23 management.

24 As Tom said, every time you go back and you change

25 a relay, you have to go back and redo your whole high

1 impedance fault analysis, and that's just not -- if the
2 licensee doesn't have to spend his money doing that, we'd
3 like to give him a tool to show that he doesn't.
4 Okay. A little bit of information about the
5 testing. As I said, we have prepared a detailed test plan.
6 The staff has reviewed it, given us extensive comments,
7 which we greatly appreciate, and we have incorporated most
8 of those.
9 The staff will be seeing the next revision of it.
10 We made a lot of changes to the test plan and they will be
11 seeing the next revision, I think, Wednesday. We're getting
12 pretty close.
13 Our focus is on control cable. The types of
14 issues that we're dealing with have mostly to do with
15 control cable, the types of 120-volt A/C MOV control
16 circuits are the ones that we're the most interested in
17 testing.
18 DR. POWERS: Can you give me an idea what the
19 conductor diameter is in the cables, the control cables of
20 interest?
21 MR. EMERSON: Well, the types of cables we'll be
22 testing, we're looking at seven conductor cables bundled
23 with single conductor cables, and I'm not the right one to
24 say what the diameters are, but --
25 DR. POWERS: But you gave me an idea.

1 MR. EMERSON: What we're trying to do is to cover
2 as many variables in a few tests as possible, such that you
3 can -- and make single variations in the tests, so that you
4 can determine the effect of a single change.
5 Some of the -- we are planning to look, to a
6 limited extent, at instrument cable. We're planning to look
7 at the differences you get between cables with thermal
8 plastic and thermal set type insulation. That was a concern
9 that NRR raised.
10 We're also going to look at armored cable to see
11 whether there's any difficulty with that. We're going to
12 look at differences in effects between the plume and hot gas
13 layer.
14 DR. POWERS: I wonder, Fred, the committee has
15 recently benefited from a dramatic presentation on the
16 effects of aging on the LOCA survivability of cable. Are
17 you looking at the possibility of running aged insulations
18 as well as --
19 MR. EMERSON: We discussed that with the NRC and
20 within ourselves and we -- in looking at the types of
21 parameters that will affect the likelihood of circuit
22 failures one way or the other, Sandia tried to characterize
23 them, and I'm not going to try to speak for them, since
24 they'll be doing that themselves, but they address some
25 parameters as having more impact on this and some as having

1 less.

2 And our understanding was that that was a

3 parameter that had less impact. So that's not something we

4 were going to try to look at specifically.

5 DR. POWERS: They were showing example that I -- I

6 believe the work is actually being done at Brookhaven

7 National Laboratory, if I'm not wrong about that, and they

8 showed us table, that it had been aged and subjected -- and

9 insulation was split and cracked and these things looked

10 horrible after exposure to the local environment, which, in

11 some respects, is more severe, in some respects, less severe

12 in a fire environment.

13 It was all very impressive, because they were

14 passing around lots of examples.

15 They didn't presume to say whether it was the most

16 important or less important, but it was very impressive.

17 MR. EMERSON: Hopefully, we'll have some videotape

18 that will be even more impressive when this is all over.

19 DR. POWERS: We'll have a war of impressions here.

20 MR. EMERSON: As I said before, we're going to

21 test both spurious device actuation and insulation

22 resistance effects, to try to correlate those two

23 parameters.

24 The one thing we're exploring right now is the

25 process we talked about earlier of how you turn the results

1 into probabilities.

2 Because we are not going to have -- because we're

3 not going to be running hundreds of tests, the likelihood

4 that we'll have statistically significant information is

5 somewhat low.

6 I mean, we're going to try to vary as many things

7 as we can and run multiple tests within a test, but

8 resources being what they are, we can't expand that.

9 So anyway, we thought that this would probably be

10 the best way for us to come up with probabilities that we

11 could put in the equation, which I will get to shortly, as

12 far as what the likelihood of spurious actuations really is.

13 So this presents kind of an overview of

14 considerations of what we're going to expect from this group

15 and we expect to provide a draft of our expert elicitation

16 plan to the staff for their consideration by the end of this

17 month.

18 DR. POWERS: Do you have a strategy for the

19 elicitation that you can share with us yet?

20 MR. EMERSON: There was a couple of course

21 documents we were looking at. I'm not an expert in this

22 area. But Nathan was very helpful in pointing out a couple

23 of references as to ways it had been done before in a manner

24 that was acceptable to the staff.

25 One had to do with the Yucca Mountain

1 characterization and the other had to do with seismic hazard
2 characterization.
3 We've looked at both of those to see how well
4 those methods match up with the type of thing we're trying
5 to do to see what's really the best way to do it.
6 DR. POWERS: I'll just kick in a third one, and
7 that is the kind of elicitation that they did for the
8 uncertainty analysis on consequence modeling from the
9 Europeans and the NRC.
10 That is yet another way. I'm not absolutely
11 certain how useful it would be for you, but it's a quick
12 read, so you may want to look at that.
13 MR. EMERSON: If you have a reference, I'd be glad
14 to look at that.
15 DR. POWERS: I think we can probably find you an
16 exact reference to it. If not, I can probably just get you
17 the pertinent pages.
18 DR. APOSTOLAKIS: Even within that, there are two
19 approaches. One is the Sandia and one is the European Union
20 approach.
21 DR. POWERS: It's the European Union approach that
22 I think I'm most interested in in this context.
23 DR. APOSTOLAKIS: I think, though, we're talking
24 about statistically significant tests and so on and this is,
25 again, where you have to understand a little better what

1 kinds of uncertainties you are dealing with.

2 Statistically significant test means I have a lot

3 of alliatory uncertainty. I want to estimate some parameter

4 and I do it many, many times.

5 Here it seems to me that most your uncertainty is

6 really state of knowledge. You don't know, given a

7 particular configuration, what's going to happen.

8 It's not a -- if I have a particular circuit and I

9 create the fire environment that you will have and I repeat

10 that experiment exactly as is a hundred times, am I going to

11 find that some of the time it fails, sometimes it doesn't

12 fail, and what is the cause of this randomness. It is that

13 I am trying to understand.

14 DR. POWERS: I'll intercede just a little bit and

15 explain and mention an experiment that I myself did in

16 connection with the TMI. We were interested in how

17 thermocouples failed when core melting takes place around

18 them.

19 We took a bunch of thermocouples and cut them off,

20 some of them shorted to the case, some of them didn't short

21 at all, some of them shorted together, some of them formed

22 junctions. They were all cut exactly the same way and, I

23 swear to God, no two of them behaved the same way.

24 And they have exactly the same problem. You've

25 got a bunch of cables in a conductor -- I mean, in

1 insulation, cable, and you heat it up. Some of them will
2 short together, some of them short to the case, some of them
3 won't short at all.
4 DR. APOSTOLAKIS: And this randomness comes from
5 what?
6 DR. POWERS: It's probably really the thermal
7 field around them and which way the conductor bends and
8 collapses and things like that.
9 It's that sort of thing. There's a lot of state
10 of knowledge uncertainty, but the alliatory component is
11 always going to be big.
12 DR. APOSTOLAKIS: So the test then will help me
13 understand a little better the alliatory part, or both?
14 DR. POWERS: I don't know.
15 DR. APOSTOLAKIS: This is something that deserves
16 a little bit of thinking, don't you think?
17 MR. EMERSON: Our tests are to try to explore some
18 of what the variables -- if you vary a test in some
19 important fashion, if you vary a parameter that you view up
20 front as being more important than another to determine what
21 the effect of that parameter is, like thermal plastic versus
22 thermal insulation, or control versus instrument cable,
23 things like that, or even the position of the conductors
24 with a seven-conductor cable, what impact that has.
25 We try to structure the test to explore, at least

1 to a limited degree, what the effect of changing important
2 parameters is.
3 DR. APOSTOLAKIS: So basically what you're saying, if I can
4 put it in different words, is yes, given a certain
5 configuration and so on, there will be a lot of randomness.
6 Now, if I change some of that basic input, how
7 does that randomness get affected; does the whole thing move
8 to lower probabilities, even though it's still random, or
9 not?
10 But you would not have a sufficient number of
11 tests to really say something meaningful about that
12 randomness.
13 MR. EMERSON: We're not going to repeat any tests
14 just identically just to determine --
15 DR. APOSTOLAKIS: Then you will not have the
16 benefit of the tests that Dana did on the thermocouples.
17 You're not going to repeat it.
18 MR. EMERSON: Right. We're not going to repeat.
19 DR. APOSTOLAKIS: Are you going to have many
20 cables, though? Identical sort of cables in the same test,
21 so at least you will have -- you will not repeat it, but you
22 will have many cables, so you would get some more
23 information.
24 MR. EMERSON: There is no --
25 DR. APOSTOLAKIS: Or a lot of thermocouples.

1 MR. EMERSON: There's no way we're going to come
2 to completely defendable conclusions with this series of
3 tests.
4 DR. APOSTOLAKIS: I understand that, but I think
5 -- have you designed those already? You're negotiating with
6 the NRC, you said.
7 MR. EMERSON: I wouldn't say we're negotiating.
8 We're getting their feedback on what the tests should look
9 like.
10 Now, they have certain regulatory goals which I'm
11 sure they will speak to with this process, as we do, too.
12 Our goal is basically to find out what happens when these
13 things burn, what happens to the devices, what happens to
14 the insulation resistance.
15 DR. APOSTOLAKIS: How do I know, for example --
16 you said that the position of a cable, of a wire, I guess,
17 inside the cable, that you will test for that.
18 But if I have a lot of randomness for a particular
19 position, if I change that, I don't know that the new
20 results I'm going to get are due to this randomness or
21 because there was really a cause and effect.
22 MR. EMERSON: That's something we're planning to
23 probably test more of, because we're varying -- I don't want
24 to get too much into the details of the test, but we are
25 planning to vary within every test the relative positions of

1 hot conductors versus conductors that are not hot within the
2 seven conductor cable.
3 And those configurations will stay the same for
4 all of the tests that we're running. So we'll have -- I
5 think we will be able to tell whether that degree of
6 randomness has anything to do with how things fail. We will
7 have a fair amount of information there.
8 Some of the other things we can't vary nearly so
9 much.
10 At any rate, this is -- I'll look forward to your
11 other method, Dana, if you -- as far as how to do expert
12 elicitation.
13 DR. POWERS: I'll try to get something to you,
14 Fred, on that.
15 MR. EMERSON: Okay.
16 DR. POWERS: Just for interest. You may find it
17 not very useful at all, but these expert elicitations, one
18 has to give some thought to them.
19 MR. EMERSON: Yes. You just don't invite a bunch
20 of guys to a meeting and expect to end up with --
21 DR. POWERS: Well, we went through five years of
22 confusion, I think, over differences on the seismic issues,
23 just exactly how you do it. I don't know that you can
24 prevent all kinds of confusion, but at least you can lay
25 down exactly how you did it.

1 MR. EMERSON: Right. And to give credit where
2 credit is due, the testing and the expert elicitation
3 process, those are being funded by EPRI in support of this
4 activity. So this is an EPRI project.
5 DR. POWERS: Once burned, twice wary.
6 MR. EMERSON: I indicated that we started with the
7 BWR Owners Group circuit analysis method as our template.
8 We are trying to make sure that if we're creating a truly
9 generic document, that all of the -- all three of the PWR
10 vendors are represented in the development.
11 So we've added members to our task force to
12 represent all three PWR Owners Groups. These are people
13 that have some conversance with how to do circuit analysis,
14 so they can contribute to that.
15 Based on the experience of the BWR Owners, many of
16 whom have PWRs, as well, they've concluded that changes
17 really are going to be relatively minor for the most part.
18 What they've done is pretty applicable to any plant.
19 So we just wanted to be sure to go the extra step
20 and make sure that it is.
21 DR. POWERS: But you'd expect that. I mean,
22 electrical circuits and electrical circuited.
23 MR. EMERSON: There are some system differences.
24 DR. POWERS: System differences. What it's
25 connected to may change a little.

1 MR. EMERSON: Right. Now, I'd like to go -- I
2 don't want to spend a huge amount of time on this, because
3 we're still in the process of making sure that everything is
4 finished, but I wanted to go through basically this
5 screening method.
6 As I indicated earlier, this talks about the
7 initial screen and this basically is an effort to cut down
8 the population, the vast population of potential circuit
9 failures into something that you can actually productively
10 analyze.
11 So we thought that taking a queue for the way the
12 regulations are set up, there is a differentiation between
13 valves that are in high/low pressure interface systems
14 versus valves that are not, in the regulations, in the
15 regulatory guidance.
16 And if you try to extrapolate that a little bit
17 further, you're concerned about that particular thing
18 because it has a very severe consequence that's hard to
19 mitigate.
20 So extrapolating that philosophy a little further,
21 we thought that the initial screen should be based with
22 similar types of consequences, not necessarily limited to
23 high/low pressure interfaces versus other types of valves,
24 but anything that might get you into the position where you
25 had a severe consequence to deal with.

1 So that's the basis for the initial screen. As I
2 said, the initial screen would be followed by circuit
3 analysis. Now, how this screening process is carried out is
4 something that the task force, we have four or five, I
5 think, PSA experts on our task force, which are still
6 working on how this is actually going to be done, but I
7 think we're making some pretty good progress there.
8 Once you get past this initial screen, you do the
9 circuit analysis, as indicated in our flow chart, and then
10 you finish with a safety significance determination process.
11 DR. POWERS: I would think that this -- just using
12 the PSA to get a categorization between immediate direct
13 unrecoverable consequences and everything else would be a
14 tremendous step all by itself.
15 MR. EMERSON: It is, because it makes the
16 difference between analysis that you can actually get your
17 arms around and analysis that you can't do anything with in
18 terms of what you have to deal with, because you can't fix
19 everything.
20 Okay. The next several slides that I will go
21 through are the ones related to the back-end screening
22 process, and I think you've seen some of the steps here
23 before and the difference between what you've seen before
24 and this is I wanted to put a little bit more detail into
25 each of the steps.

1 So I'm not going to be able to spend a huge amount
2 of time on each individual step, but instead just fairly
3 broadly characterize each one and then let you ask questions
4 about it.
5 The steps are intended, again, from the standpoint
6 of user-friendliness, to begin with things that can be done
7 more easily and at lower cost by the licensee, and are also
8 more conservative.
9 Then as you go farther along through the screening
10 process, you get steps that are harder to do, but remove
11 more conservatism.
12 DR. APOSTOLAKIS: It seems to me, Fred, that the
13 only one you can reasonably defend is the last one,
14 conditional probability of core damage given the
15 fire-induced spurious actuation. All other factors are so
16 subjective, I can get any number I want to.
17 MR. EMERSON: But we have data on fire frequency.
18 DR. APOSTOLAKIS: Fire in the building. Right?
19 Maybe that's the next one. You're not going to have it for
20 a specific area. You will have to go to the second factor
21 there, B-sub-E, to specialize the thing from a building
22 fire, to an area fire, to a specific location, and size.
23 In the old fire risk assessments that we were
24 doing with Nathan several years ago, this factor, in fact,
25 was three or four factors and this is the major problem

1 here, that it has to be subjective.

2 I mean, you can use arguments of various sorts,

3 but then you will not have any kind of analysis to really

4 give you a basis for the probability that automatic

5 suppression will or will not control the fire.

6 So it seems to me that your second through the

7 fifth factors are so arbitrary, that I don't know that this

8 is going to work at all, to take an extreme position.

9 MR. EMERSON: Well, I guess I would say some of

10 them are harder to pin down exactly than others. I would

11 agree with that.

12 But I think we've done fire risk analyses, we have

13 made efforts to determine what the likelihood of this is

14 happening. We've made efforts in existing fire analyses to

15 try to address the probability that automatic suppression

16 won't control the fire.

17 This may be a little arbitrary, but it's based on

18 the testing we're going to do, and that's where those

19 numbers are going to come from and the results of this

20 expert elicitation process.

21 So whether it's arbitrary or not, we're going to

22 build on existing methods as best we can, so that we --

23 DR. APOSTOLAKIS: Well, Fred, it depends on what

24 you call existing methods. I have been quoted in some of

25 these documents as having come up with a probability of a

1 hot shot. I'll be the first one to knock it down. That was
2 20 years ago and I, frankly, don't even remember the context
3 when I did it.
4 So if you are building now on something that is 20
5 years old, I mean -- so I'm not sure. I sound particularly
6 harsh, but I think this is where you're going to have your
7 problem.
8 DR. POWERS: I guess I don't even understand the
9 equation as it's written now. We've got this frequency of
10 any size fire. And it seems to me there ought to be a --
11 the delta CDF should be a summation over all fires weighted
12 by their frequency.
13 Maybe that is what's intended here.
14 MR. EMERSON: You mean what the fraction of fires
15 is that results in the types of impacts that you'll have?
16 DR. APOSTOLAKIS: I think what Dana is raising is
17 the issue of looking at the aggregate scenario versus
18 looking at individual scenarios where each one can be
19 dismissed. But if you take them as a group, you see, fire
20 size, you have a number of fire sizes.
21 MR. EMERSON: Yes.
22 DR. APOSTOLAKIS: If you make your intervals small
23 enough and say between this and that, then I dismiss it
24 because the probability is nothing. But then if you
25 consider the whole spectrum of sizes, it is significant.

1 MR. EMERSON: I understand your point and I think
2 when you actually get into the details of each step, what
3 you start with is a pretty conservative frequency that
4 covers a lot of different possible types of fires. And as
5 you work your way through, this is a step that allows you to
6 be a little bit more specific.
7 The fire modeling will end up -- will make it even
8 more specific and you gradually remove some of the -- once
9 you pin down the types of fires that are more likely here,
10 then you can reduce this rather broad frequency of a lot of
11 different kinds of fires to something that's more realistic
12 to that fire area and that particular cable location.
13 DR. APOSTOLAKIS: That's the intent and, of
14 course, you should do that. The question is how to do it.
15 For example, should you consider a specific size or at least
16 this size. It's a different approach, because then one is
17 aggregate, the other is not.
18 And what if you have three or four realistic
19 locations, should you take the sum of the contributions and
20 compare it to the criteria or consider each one separately?
21 DR. POWERS: And on top of that, you come in and
22 you say you've got a formula there that says each one of
23 these factors is independent, but when I read the
24 description of them, they don't look like they're
25 independent.

1 DR. APOSTOLAKIS: That's right.

2 DR. POWERS: It's very hard for me to believe that
3 the size of fire is independent of the probability that the
4 automatic suppression system won't control the fire.

5 DR. APOSTOLAKIS: The manual especially.

6 MR. EMERSON: Nathan gave us the same comment
7 about, I don't know, nine months ago.

8 DR. APOSTOLAKIS: Who did?

9 MR. EMERSON: Nathan, at a meeting.

10 DR. APOSTOLAKIS: Oh, what a surprise.

11 MR. EMERSON: So since that time, we have worked
12 --

13 DR. APOSTOLAKIS: He was there at the creation.

14 DR. POWERS: Nathan, then you're older than you
15 look.

16 MR. EMERSON: So we have worked very hard to try
17 to -- you know, we took that comment to heart and we've
18 tried to make sure that when you get to look at each one of
19 those parameters very hard, that they are independent, that
20 they are, in fact.

21 DR. POWERS: But what I see in your document is
22 just the assertion that there is independence. At no time
23 in the document do I see anything that I would say that
24 guards against having values of that that don't have a high
25 degree of correlation with the preceding value.

1 MR. EMERSON: The document, the version of the
2 document that you saw was written last April. Since that
3 time, we've done a great deal of work which has not been
4 reflected yet in subsequent drafts.
5 DR. POWERS: So I'm just out of date. I knew
6 that, in a lot of areas.
7 MR. EMERSON: Well, let's just say that you
8 haven't seen all of the more recent work yet, because we
9 haven't -- because we're still working on it.
10 DR. APOSTOLAKIS: I think there is another comment
11 here.
12 MR. NAJAFI: To address both of those issues, this
13 formula is not applied to a specific fire. When you define
14 the frequency of the fire size, there has been methods that
15 have been used in the IEEE program in the past five or six
16 years, that it asks you to look at different sizes of fire
17 and different sources of fire.
18 So if you go inside a plant, let's say, a switch
19 gear room, you don't say probability of a fire here is X and
20 walk out. You define the probability of the fire in that
21 room or frequency of the fire in that room that corresponds
22 to a specific type of fire.
23 So you walk out of that room with maybe four,
24 five, six different fire sources and frequencies associated
25 with each one.

1 DR. APOSTOLAKIS: So this formula then should have
2 a big sigma applied.
3 MR. NAJAFI: Yes, there is a sigma. Yes. There
4 is a sigma. And as I said --
5 DR. APOSTOLAKIS: It's an invisible sigma.
6 MR. NAJAFI: There is a sigma and even not only
7 it's reflected in the equation, it's reflected in your
8 screening. The sigma, you don't screen one scenario at a
9 time. You do not. Even the screening method that says go
10 within your are boundaries and even within area boundaries
11 says watch for what does that do to your overall risk before
12 you throw it away.
13 So that's the first one. The independence, we
14 have taken a great deal of work trying to define each
15 element. I know that you have to do. It's statistics 101.
16 And these parameters, to the extent possible, they have been
17 defined to account for the conditions imposed by the
18 previous event.
19 DR. APOSTOLAKIS: But the assessment is very
20 subjective, though.
21 MR. NAJAFI: That is correct. But that's no
22 different than has been developed methods 1150, EPRI's
23 methods, in the past four or five, ten years, to be used for
24 fire risk assessment.
25 DR. APOSTOLAKIS: I will come back to my earlier

1 comment. Appendix R really addressed the last factor, did
2 it not? The conditional probabilities, postulate the fire
3 and show me that you can shut it down. In essence, that's
4 what it does.
5 MR. NAJAFI: Yes. Appendix R established a design
6 basis fire. That it basically engulfs all the first four or
7 five and puts a probability of one to it.
8 DR. APOSTOLAKIS: That's right.
9 MR. NAJAFI: PRA, what it does --
10 DR. APOSTOLAKIS: Not the probability of one. It
11 says assuming that you have it.
12 MR. NAJAFI: Yes, whatever, given, but it does not
13 go back and assign a frequency to what it assumed.
14 DR. APOSTOLAKIS: Because it's a traditional
15 deterministic rule.
16 MR. NAJAFI: Deterministic, exactly. Here, we're
17 building, in a sense, a series of design basis fires and
18 we're defining these scenarios that, in turn, become your
19 design basis fire.
20 DR. APOSTOLAKIS: And that's my concern. I mean,
21 we seem to be risk-informing here something that -- and
22 we're making a huge change, and I don't know that we have
23 really gone through the proper process to do that, because
24 Appendix R is the last bullet and now you're adding all the
25 other stuff.

1 And at least if there were some serious technical
2 basis for the estimates there, I wouldn't mind it, but I
3 think you're going to have big problems convincing anybody
4 that you can screen out things based on the
5 ten-to-the-minus-X you are going to get for these factors.
6 And it's not just me.
7 DR. POWERS: I agree with you. I think they've
8 got a problem of not just independence, but of database.
9 DR. APOSTOLAKIS: I mean, we've done it so many
10 times.
11 DR. POWERS: And I really have troubles with the
12 weighting factor here.
13 DR. APOSTOLAKIS: I mean, on what basis can an
14 analyst give you a probability that the automatic
15 suppression will not control the fire? On what basis can
16 you do that? How many has he seen? Especially when the
17 thing is a large size.
18 Jack, I'm sorry, but you don't see these people,
19 so that's why.
20 MR. HENNEKE: I'm Dennis Henneke from San Onofre.
21 I guess I'm going to stand up here and talk about this, even
22 though I'm on the NFPA committee.
23 We have been applying these for years. So we come
24 up with ways to apply them. The EPRI guidance and the
25 general guidance that we get for applying any of these is

1 out there, it's reviewable. Some things the NRC doesn't
2 like, some things they do.
3 But we've been doing this for many years in our
4 IPEEEs and our fire PRAs are all based on these methods.
5 I guess if there are specific methods that are not
6 useable for this, then we need to know what that is, but
7 we're not re-creating the wheel here in this formula. This
8 formula is no different than EPRI-5 or other methods that
9 we've used.
10 We're just saying apply them in a conservative
11 manner and then screen, and, for example, the one you said,
12 automatic suppression won't control the fire, what we're
13 talking about is a fire that is away from the cable. So if
14 the cable is right over the fire, the probability of that is
15 one. There's nothing subjective about that. We say it's
16 conservative that the suppression will not extinguish a fire
17 prior to the cable burning.
18 If the cable is on the other side of the room and
19 eventually a hot gas layer will fail that cable, then now we
20 can look at the timing using comp burn runs or any other
21 fire analysis and say that cable and the temperature will
22 get to a certain temperature, using conservative comp burn
23 runs, in X minutes, you know, is the detection going to
24 detect it prior to damage. The answer is yes.
25 DR. APOSTOLAKIS: If you do that, then I would not

1 have that much of a problem.

2 MR. HENNEKE: So then that number is just the

3 availability, reliability or unavailability of the fire

4 suppression system itself, and that's the same thing with

5 manual suppression. Can manual suppression get there in

6 time and if they can, then how quick can they respond to

7 that particular fire? Nothing subjective about it.

8 DR. APOSTOLAKIS: The only factor then is that is

9 not amenable to these kinds of considerations, which I think

10 are reasonable considerations. This is the second one,

11 realistic location and size of the fire. That has to be

12 subjective. I don't know what other basis you will have.

13 MR. HENNEKE: Well, no. I mean, the way we do it

14 is we'll take a room apart and if we go to a cabinet room

15 that's got nine cabinets, and then we have, say, transient

16 fires and we have ten fires there, we have to look at each

17 of the fires.

18 We say, okay, let's take the worst case fire, just

19 burn the entire room down, and we can apply the factors, all

20 the factors are one.

21 You are not going to protect the cable. Because

22 of the cable you can't figure out where the fire is so you

23 start applying size parameters or location parameters, you

24 are talking about specific cables you are protecting. So if

25 you have a cable on the corner of the room that you are

1 trying to protect, then you can apply that fire. And then,
2 basically, you won't be protecting the fire for -- a fire in
3 that corner.
4 But oftentimes what we are seeing are these
5 circuits are going along cables in a room and you are saying
6 you have got to protect these multiple circuits, and there
7 is no source under the fire, it is just cable and open
8 floor. And so you say --
9 DR. APOSTOLAKIS: But you might have a transient.
10 MR. HENNEKE: So then they start applying that
11 particular part of the formula in that way. So it is not --
12 you can't just say we are going to put a fire in the room,
13 you have to run scenarios. Yes, we understand that, and
14 that is why we have got a big summation time in front.
15 But, you know, he is describing a very generic
16 method, but once you apply it to particular rooms, it is
17 very easy to see where the numbers we come up with can be
18 substantiated using generic methods. I think a lot of the
19 IPEEE comments and problems have been a misapplication of
20 some of these or the general, too general of a guidance on
21 how to apply manual suppression or something like that.
22 But, you know, if we apply the science correctly, I think it
23 is all there.
24 One thing, you know, we have talked about is
25 this --

1 DR. APOSTOLAKIS: I am not as optimistic as you
2 are, but anyway.
3 MR. HENNEKE: What we talk about here is being
4 conservative in the screening. And so when we screen a
5 scenario out, or we screen these fire set of cables out, we
6 want to screen it out from a conservative manner. If we not
7 sure, we apply a conservative factor. And if it doesn't
8 screen, then we look at it further.
9 DR. APOSTOLAKIS: And what I am saying is that you
10 are going to have a lot of debates with the staff as to what
11 is conservative.
12 MR. SIEBER: Yeah. I think we need to move on.
13 We have five minutes to cover about 30 slides.
14 DR. APOSTOLAKIS: Okay. And all this was the
15 critical one, the rest --
16 [Laughter.]
17 MR. EMERSON: As explained, there is a slide, the
18 remaining slides deal with each of these screening steps as
19 to what goes into that. And I am just going to, I am going
20 to run through them very rapidly because of the time
21 constraint.
22 The first screening step is a qualitative
23 screening step with a quantitative basis. And you haven't
24 seen all of the bases behind it, but it is a quick and dirty
25 way to say, what is the frequency? What is the circuit

1 failure probability? What do I have left that can protect
2 me if I have a circuit failure, and can I screen it out
3 based on this? And this is a very conservative first step.
4 The second step on the screen one again is the
5 table that is applied there is this one. The numbers tell
6 you how many defense-in-depth elements you need to protect
7 if you have been able to define the probability of spurious
8 actuation in the fire frequency in one of three ways each.
9 Trust me, you will see the basis for all of this,
10 not in this presentation.
11 DR. APOSTOLAKIS: Let me jump to the regulatory
12 issues, Mr. Chairman.
13 That is interesting. I mean here I can raise a
14 million questions, I don't want to.
15 MR. EMERSON: I can skip all of this is what you
16 are --
17 DR. APOSTOLAKIS: No, I think the regulatory
18 issues is interesting.
19 DR. POWERS: I think we have examined the document
20 and what you are telling us that we are out of date on that.
21 DR. APOSTOLAKIS: Right.
22 DR. POWERS: So I think the questions we ask might
23 be anachronistic.
24 DR. APOSTOLAKIS: Well, they could be.
25 DR. POWERS: Could be anachronistic.

1 MR. EMERSON: I will take an action item to
2 provide the next draft of the document for you to look it.
3 DR. POWERS: That would be great.
4 DR. APOSTOLAKIS: So you have three utilities who
5 have volunteered plants for pilots?
6 MR. EMERSON: Wait, I haven't caught up with you
7 yet, George.
8 DR. APOSTOLAKIS: I am trying to help you.
9 MR. EMERSON: Okay.
10 DR. APOSTOLAKIS: Bring you back to issues where
11 there is no uncertainty, I believe there are three.
12 MR. EMERSON: Okay. You are on the pilot slide.
13 DR. APOSTOLAKIS: Yes.
14 MR. EMERSON: Okay.
15 DR. APOSTOLAKIS: NEI-0001 pilots, yes.
16 MR. EMERSON: Okay. Three utilities have
17 volunteered plants as the slide indicates.
18 DR. APOSTOLAKIS: Which ones?
19 MR. EMERSON: I am not going to say yet because
20 the utilities themselves haven't identified the plants to
21 me. We have a lot of water to flow under the bridge before
22 we can do that. But let's just say, I will say that we will
23 be able to test some cross-section of plants, so it is not
24 just one type. We want it to be a fair evaluation.
25 DR. APOSTOLAKIS: Now, what difference does it

1 make, PWR versus BWR, is it the location that will be
2 different?
3 MR. GORMAN: They are different systems.
4 SPEAKER: Different equipment.
5 MR. GORMAN: The configurations of the plants.
6 DR. APOSTOLAKIS: In terms of the fire issues we
7 have been talking about, it seems to me that the location,
8 and the last one there, condition of core damage, which here
9 it is almost -- it is not part of this effort. Your focus
10 is really on screening criteria and the various
11 probabilities for the fire size, suppression, detection.
12 These are independent of a BWR repeated flaw.
13 MR. EMERSON: That's correct. But because we have
14 two distinct types of plants, one of which has spent a great
15 deal of time and effort, and the other type which has not,
16 we want to be able to show that this is fully applicable to
17 both.
18 DR. APOSTOLAKIS: Oh, yes.
19 MR. EMERSON: Okay. This is what Leon asked me to
20 address, so I am going to address it.
21 DR. APOSTOLAKIS: Who asked you to address it?
22 MR. EMERSON: Leon Whitney of NRR. We have had
23 several meetings with the staff recently where we have
24 discussed circuit failure issues, and the NRR has identified
25 a list of issues which they would like to see resolved by

1 some combination of the testing and/or the NEI method. So I
2 would like to address those here, and the next several
3 slides address these.
4 These are the issues that we think are addressed
5 by the testing in isolation from the rest of the work that
6 we are doing. The any and all, one at a time, whether you
7 postulate one spurious actuation one at a time or
8 simultaneously, we expect to address that in the testing.
9 We expect to address the timing of how circuits fail, how
10 long, what kind of duration you need. How long does it take
11 to get to the point where they start failing, et cetera?
12 And we intend to address the cable configuration
13 considerations as to, are you likely to get failures --
14 conductors in the same cable, cables in contact with each
15 other, cables in the same tray, and try to explore all of
16 those variables with the testing.
17 We are going to try to address Information 92-18
18 phenomena, which, to refresh your memory is whether you get
19 damage to a component from bypassing protecting circuitry
20 from a spurious actuation. Cable failure probability
21 dependency on circuit design. We have talked about some of
22 the variables we are going to try to address, some of the
23 different types of ways we are going to vary how the
24 conductors appear on the circuit. And so we will be able to
25 address this to some degree, not in exhaustive degree.

1 The issues that we see being addressed by the
2 larger document, NEI-0001 are the factors affecting the fire
3 severity and consequence through the equation we talked
4 about is intended to explore how likely it is that you will
5 get fires of a sufficiently large size to create cable
6 damage. Information Notice 92-18 also appears on this list,
7 as it did on the previous slide, because our document will
8 address that. I indicated earlier it will address multiple
9 high impedance faults and how likely they are.
10 And a top called inherent circuit safety
11 assumptions, and as I understand it, that has to do with
12 whether a circuit is grounded or not, or what kinds of
13 assumptions you make about the inherent safety of a circuit,
14 just based deterministically on its design, and we will
15 address that to some extent.
16 There are some issues, again, this list overlaps
17 with some other ones that are addressed by current design.
18 Control room cabinet configuration. We didn't intend to
19 explore that explicitly in our document, but I think the
20 Owners Group document covered that in some degree as to they
21 explored the likelihood of control room fires and how they
22 were likely to expand from one to another. And the MHIF
23 also appears here because, through circuit coordination,
24 circuit breaker coordination, plants have addressed this
25 issue, and inherent circuit safety assumptions also appears

1 on this list.

2 So that is a very quick run-through as to --

3 MR. WHITNEY: I would like to add something here.

4 MR. EMERSON: Sure.

5 MR. WHITNEY: Leon Whitney, Plant Systems Branch.

6 What we asked Fred to do was to look at what technical bases

7 he was going to derive from his fire testing in relationship

8 to all this subject, and that is what I asked him to

9 consider. We saw three or four major ones upfront, but we

10 didn't see where the technical bases was going to come out

11 of the fire testing. We were curious as to where that

12 technical basis was going to come from. I am still a little

13 unclear as to where that is.

14 MR. EMERSON: Well, hopefully, it will be clear as

15 we go along.

16 Okay. The remaining slides have to do the

17 recommendations for staff. I didn't get a chance to go

18 through the other presentation, but, basically, it was there

19 are several methods out there, several different groups of

20 developed guidance documents which pertain to this issue.

21 And there have been comparisons of one guidance document

22 versus another and how valid one is versus how valid another

23 is.

24 We think that with the addition of a risk-informed

25 method for addressing circuit analysis issues, that this

1 presents the strongest case for resolving the issue as
2 opposed the licensing space type arguments that I alluded
3 to.
4 DR. APOSTOLAKIS: But you said earlier, Fred, that
5 you don't want -- the position of NEI is that you don't want
6 to risk-inform Appendix R. Yet, you are adding risk
7 information to it. Why?
8 MR. EMERSON: Okay.
9 DR. APOSTOLAKIS: Why don't you want to
10 risk-inform Appendix R?
11 MR. EMERSON: I will address that. Now, we are
12 not opposed to risk-informing Appendix R. What we are
13 opposed to is a licensee who has 20 years of operation with
14 an existing design basis forcing him to go back and redo his
15 whole licensing basis just for that.
16 Now, we are all for adding risk to the
17 consideration of fire protection issues. Now, there are a
18 lot of utilities that support doing that. Now, NFP 805 may
19 be one way to do that, and we will talk about that more this
20 afternoon. But we are definitely all for being able to add
21 risk to the mix, to what has been the traditionally
22 deterministic fire protection area.
23 DR. APOSTOLAKIS: But you see what you are doing
24 here is you are using risk analysis for a specific purpose,
25 to show that the potential issue may not be an issue, and

1 you are not giving the chance to risk analysis to raise
2 other issues, that is the problem with this approach.
3 Either you risk-inform the appendix or you don't. You can't
4 use it selectively to say I will dismiss things based on the
5 risk assessment, but I will not give you the chance to raise
6 other issues using risk assessment.
7 MR. EMERSON: I think the opportunity exists to
8 raise issues. The staff --
9 DR. APOSTOLAKIS: As you have found out.
10 MR. EMERSON: The staff raises issues, and this
11 gives us another tool for us to determine how significant
12 they are, as opposed to just saying, well, just being an
13 argument one way or the other, staff versus industry, and
14 this is important -- yes, it is; no, it isn't.
15 So we hope to expand our use of risk information
16 in other areas as we go along.
17 MR. SIEBER: Thank you. Any other comments or
18 questions from the members?
19 [No response.]
20 MR. SIEBER: I would to thank Mr. Emerson for his
21 presentation.
22 MR. EMERSON: Again, thank you for the
23 opportunity.
24 MR. SIEBER: And I think we can take our lunch
25 break now. And I would like to --

1 DR. POWERS: Let me just interject again that Fred
2 organizes one of the most tremendous conferences that I
3 think the members of the subcommittee can attend, the Fire
4 Protection Forum. And, Fred, correct me if I am wrong, your
5 next one is in beautiful downtown San Diego or something?
6 MR. EMERSON: You got it.
7 MR. SIEBER: When?
8 DR. POWERS: In February, I believe.
9 MR. EMERSON: February 5th through the 7th.
10 DR. POWERS: And I would like say both Jit and I
11 have attended these things and I would like to say that
12 these are outstanding. Fred has made it -- he gives you the
13 red carpet treatment when you attend.
14 SPEAKER: Do you remember the dates?
15 MR. EMERSON: February 5th through 7th.
16 MR. SINGH: We can't go then.
17 DR. APOSTOLAKIS: Why not?
18 MR. SINGH: We have a meeting at ACRS that week.
19 DR. APOSTOLAKIS: The meeting is in Washington.
20 MR. SINGH: In Washington.
21 DR. POWERS: I will remend the member that he has
22 the opportunity to suggest that the date of that meeting be
23 changed.
24 DR. APOSTOLAKIS: I just remembered that.
25 DR. POWERS: Because it is -- I mean what Fred has

1 done is he has organized a forum where there is a chance for
2 a real technical exposition. Staff, NRC staff gets
3 involved, a tremendous cross-section of industry attends.
4 There is a real frank technical exposition on the issues at
5 this that nowhere else have I seen such a useful, I would
6 say almost working group type forum involving presentations,
7 but, of course, like all conferences, the side discussions
8 are by far and away the most valuable thing.
9 You get real insights not only on the philosophy
10 behind safety regulation, but the challenges that are faced
11 in actually applying some of these ideas and whatnot, and it
12 is a real refreshing give and take technically by sincere
13 people trying to do a good job.
14 DR. APOSTOLAKIS: By the way, the ACRS meeting is
15 the week before.
16 DR. POWERS: And Fred really deserves a lot of
17 credit for organizing those really well.
18 MR. EMERSON: Thank you. We try to strike a
19 balance between regulatory, technical and practical fire
20 protection issues.
21 DR. APOSTOLAKIS: Do you mean regulatory issues
22 are not practical?
23 [Laughter.]
24 DR. POWERS: There are those of us who --
25 MR. SIEBER: Yes. I think we should recess now

1 until 1:30.

2 [Whereupon, at 12:39 p.m., the hearing was

3 recessed, to reconvene at 1:30 p.m., this same day.]

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1 AFTERNOON SESSION

2 [1:30 p.m.]

3 MR. SIEBER: I'd like to call the meeting back to
4 order. This afternoon, we will have a presentation by
5 Nathan Siu of the Office of Research, and Steve Nowlen from
6 Sandia National Laboratories on research activities in the
7 fire protection area.

8 DR. POWERS: Mr. Chairman, before we get started,
9 I'll have to acknowledge that I actually know who Steve
10 Nowlen is, and sometimes I've even in the vague vicinity of
11 his office, so to be deemed totally incredible when any
12 comments are made about the work done at Sandia National
13 Laboratories.

14 MR. SIEBER: So noted.

15 MR. SIU: Good afternoon, my name is Nathan Siu
16 with the Office of Research, PRA Branch.

17 As the Chairman has noted, sitting with me is
18 Steve Nowlen from Sandia National Laboratories. At the
19 table over there is Mark Cunningham, the Branch Chief of
20 PRAB, Fire Protection Chief, NRR.

21 Behind them is Roy Woods, who is the Project
22 Manager for the Fire Research Program, the work done at
23 Sandia.

24 I'd like to just bring you up to date as to what's
25 been going on in the fire research program. I think we last

1 briefed the Committee a little over a year ago on where we
2 were planning to head.
3 Some things have happened, naturally, since then,
4 and we'd like to tell you about some of our results and
5 where we're heading.
6 So I'm going to give you an overview of the
7 research program plan, and that includes a background of
8 where we've come from to get to this point.
9 I'm going to talk about how we're implementing the
10 plan, and, in particular, I'm going to talk about some of
11 the results we've obtained from looking at the circuit
12 failure issue, which is something that we talked about this
13 morning or that was discussed this morning.
14 Also, we're going to talk about some of the
15 lessons we've learned from reviewing some major fire events
16 that have occurred in the nuclear industry worldwide.
17 Then we're going to talk about how we're updating
18 the research program to meet some of the evolving needs of
19 the Agency, including addressing some of the issues raised
20 by ACRS in its comments on the Fire Risk Research Program.
21 DR. POWERS: Nathan, as you go through the
22 research program, can you tell me, explain to us, what the
23 Agency targets for fire risk assessment that is -- do they
24 see a tool that could be routinely used by people in the
25 Regions or routinely used by the Senior Reactor Analysts, or

1 is it all kind of a qualitative sort of thing?

2 MR. SIU: Well, that's a good point. In the early

3 version -- not the early -- the initial version of the plan,

4 which you've seen, the target was primarily developing

5 improved tools that unnamed people could use in performing

6 improvement analyses.

7 And that was -- the unnamed people, of course,

8 could be anybody, ranging from staff through industry,

9 outside reviewers, whatever.

10 We've tried to fine-tune some of the targets a

11 bit, and you'll see some of the tasks are aimed at much more

12 specific applications.

13 So, in some places, we might be developing

14 improved guidance, for, for example, somebody who is

15 reviewing a fire PSA, and in other places, of course, will

16 continue to develop improved tools and data.

17 And if you wait till about maybe halfway --

18 actually after Steve gets through with his presentation,

19 you'll see some of the things that we're trying to address

20 in the updated program plan.

21 DR. POWERS: When I look at things like the

22 significance determination process for fire safety, I see an

23 enormous number of parameters whose origin is obscure, and

24 upon interrogation, I'm told they come from five, and when I

25 go into five, the obscurity reemerges.

1 MR. SIU: Yes.

2 DR. POWERS: Are we trying to get that --

3 MR. SIU: Oddly enough, that's a specific task in
4 our program at this point, so, yes, we are trying to get a
5 tighter connection with a number of the activities going on
6 in the Agency.

7 DR. POWERS: Very good.

8 MR. SIU: Just again as some background, the --
9 let me get to my paper here.

10 [Pause.]

11 We did brief the Committee on where we were
12 heading in 1999. And we mentioned the specific objectives
13 of the program, which included looking at -- understanding
14 fire risks better, supporting ongoing fire protection
15 activities, and also developing fire risk assessment methods
16 and tools as needed to support those previous objectives.

17 We did -- in our initial plan, we were talking
18 about evolutionary improvements over the existing
19 technology. We discussed how were going to use existing
20 information, in, if you will, a data mining kind of mode to
21 extract information that we could better use in the fire
22 risk assessments.

23 And we talked about using feasibility and scoping
24 studies in places where the going got tough. And that was
25 trying to deal with the resource constraints that we had and

1 time constraints as well.

2 We did issue the research plan in June of 1999,

3 and I believe, again, that the Committee has that.

4 The tasks that we initiated at the beginning are

5 these 15 tasks here, and they covered a wide range of

6 issues. First and foremost, again, you see the circuit

7 failure mode unlikelihood analysis.

8 That was our top priority issue, and we've devoted

9 a significant amount of time and effort on that, and issued

10 a report that, again, I believe the Committee has a copy of

11 that.

12 We are continuing to work on that to finish up a

13 few pieces that we left untouched in the initial report, and

14 Steve will talk to that a little bit later.

15 But again, we have issues covering or tasks

16 covering a wide range of topic areas in fire risk

17 assessment, and some of these cover some of the issues that

18 we were discussing this morning, for example, on fire

19 detection and suppression analysis. We do have an effort

20 underway looking at that particular topic, and time

21 permitting, of course, we can get back to these issues and

22 answer questions as the Committee sees fit.

23 At this point, I was just planning on listing the

24 topics here. Again, in the research plan, we do have a

25 description of what the work involved is, and what we're

1 aiming for, and how we're going to get there.

2 So, there are specific topics that are concerns

3 raised in the program plan that explains what is the

4 specific technical objective of each of these tasks. And,

5 again, we can talk about that, but at this moment, I was

6 just hoping to leave you with this list.

7 The plan is being revised now, and we'll get to

8 the plan revision --

9 DR. APOSTOLAKIS: What, exactly, are you doing in

10 the model uncertainty area?

11 MR. SIU: Okay, that is an area -- this is a topic

12 that is being covered by the University of Maryland. And

13 the topic here, in some ways is a very familiar topic to us,

14 and when we were doing the early fire PRA studies, the

15 question came up, if you use a particular fire model, say,

16 COMP-BURN, and you have a limited amount of data to

17 benchmark the predictions of that code, and the data are

18 fuzzy, as of course, the prediction, because of uncertain

19 parameters, how you deal with that uncertainty.

20 That work branched off and started exploring a

21 little bit more carefully, the nature of the model

22 uncertainties, in particular, and suggested methods for

23 addressing those, quantitative methods.

24 There has been some work on applying those methods

25 to fire applications. We don't have the final report on

1 that just at this moment, but it's imminent And, of course,
2 I'd be happy to pass that on to you when it becomes
3 available.
4 One of the things they're addressing, for example,
5 is the issue of the mixed model picture, which model is more
6 correct than another, versus do the models simply represent
7 different forms of evidence that you can use in
8 quantification?
9 So, again, we'll have more to say on that fairly
10 shortly, I hope.
11 Just to let you know the kinds of outputs that
12 we've generated to date: Again, we have a report on circuit
13 failure mode unlikelihood analysis, and that one has been
14 publicly distributed. It was circulated for comment for
15 quite awhile, and we did receive a number of comments from
16 around.
17 We have a draft report on experience from major
18 fires, which we've passed on to the main body of the report
19 to the Committee, and has substantial appendices. Of
20 course, we're happy to pass the appendices on as well, but
21 just for the sake of limiting the amount of paper, we
22 thought we'd give you just that and leave it open to
23 question.
24 That report is not yet publicly distributed, but
25 we do intend to have that published as NUREG CR report when

1 we get all our final internal comments back.

2 We have put together a CD ROM -- or Sandia has

3 done this for us -- a CD ROM containing data from a number

4 of fire tests that the NRC has sponsored several years ago,

5 but had never published that data.

6 Now that data is now available and it has been

7 circulated widely among the fire modeling community as

8 another source of information for people to benchmark the

9 models.

10 We just briefly mentioned this notion of the

11 integrated treatment of model and parameter uncertainties.

12 And we've also been providing technical support in

13 variety of areas, such as supporting the ITEEE program. In

14 specific, questions come up, say, on the treatment of the

15 hot gas layer and the heat loss factor associated with that

16 hot gas layer.

17 We've provided support to industry, providing

18 comments back to them on proposed test programs, as Fred

19 mentioned this morning.

20 And that has actually gone on before as well, when

21 the EDF was performing some tests and industry was

22 interacting with the EDF. We provided comments on that test

23 program also.

24 And, of course, we're providing support or have

25 provided support to the development of NFPA 805.

1 Okay, at this point, I'd like to turn it over to
2 Steve Nowlen who is going to talk about two specific tasks,
3 the circuit analysis task and the major events task.
4 MR. NOWLEN: Okay, can you hear me? Okay, fine.
5 The first task I'm going to go through is the
6 circuit analysis tools task that we performed. I want to
7 acknowledge my co-authors on this study who are Jeff
8 LaChance and Frank Wyatt, both of Sandia.
9 And I apologize for the first typo in my
10 presentation, the ACRA Committee, I don't know who that is,
11 but, oh, well.
12 What I'm going to do is, basically this task had
13 five major objectives, and what I want to do is go through
14 each of those objectives and use that as the basis for the
15 presentation. I'll give you an idea of what we found, the
16 insights we gained, the recommendations, if any, that came
17 out of each objective, and where we are and where we think
18 we might be going with some anticipated followon in some of
19 these areas.
20 So, our first objective was to improve our
21 understanding of the mechanisms that link cable damage to
22 potentially risk-significant failure modes of power control
23 in instruments circuits.
24 This gets to a lot of what Fred was talking about
25 this morning, that what we're really concerned about here is

1 spurious actuations and other types of circuit effects.

2 But what we deal with on a mechanistic level is

3 the failure of cables, in particular. So there are

4 mechanisms that connect those two together. For example, a

5 hot short is not a spurious actuation, necessarily.

6 It takes the right hot short to get a spurious

7 actuation. So it's that link between those behaviors, the

8 physical behavior of the cables and then the behavior of the

9 circuit.

10 So, what we did is, we did a data review, trying

11 to get at the behavior of cables and how they fail. We

12 looked at data from a number of sources, public literature.

13 Basically we scoured the world for what we could find in

14 terms of data.

15 We did find for certain types of configurations,

16 there is a fair amount of data. Fred mentioned this morning

17 that these tests are not typically done to look at failure

18 mode, and that is correct.

19 Many of these tests were flammability tests or

20 suppression tests, or coating tests, you know, who knows?

21 They were not typically done for this purpose, but there is

22 information in these tests that tells you what type of

23 failures did occur for certain types of cables. It remains

24 limited.

25 For multiconductor cables, there as a fair amount

1 of data on conductor-to-conductor shorts, in particular.
2 That's what most people who were doing this testing looked
3 for, multiconductor cables, conductor-to-conductor shorting.
4 And so what we found there was the likelihood that
5 conductor-to-conductor shorts occur first was relatively
6 high. Again, in a sense you have to say that's what you
7 look for, that's what you found.
8 So, it's not incredibly surprising, but, again,
9 the overall likelihoods were relatively high.
10 One thing that we also found was that there was no
11 experiment that ever showed that an open circuit fault was
12 the first mode of failure.
13 We did see some open circuit faults occur, but it
14 was always after a series of high voltage, typically high
15 energy faults to ground that would repeatedly pop and
16 eventually a cable would break open.
17 But again, as an initial fault mode, it just never
18 appeared. So that was kind of interesting, and there were a
19 number of things that came out of that.
20 The next thing we did is, we looked at some case
21 examples, and we took sample circuits out of actual plant
22 applications, and performed circuit analysis on those
23 circuits to show what kinds of faults were important for
24 those circuits, what kinds of things led to spurious
25 operation, in particular, but also looking at other types of

1 behavior on the circuits.

2 And we looked at MOV and SOV pump motors and some

3 relay circuits. We looked at cable failure modes, in

4 combinations, and looked at the impact of the circuits on

5 the circuits.

6 And that was also rather interesting. You see

7 that combinations of faults within a multiconductor control

8 cable, for example, associated with an MOV may lead to

9 spurious operation. It may lead to a loss of function, it

10 may lead to loss of function when you attempt to operate the

11 device, so there is a range of things that can happen.

12 You can get misleading indications, so it's not a

13 -- it works or it doesn't work, or it spuriously operates,

14 kind of thing. There are more than just those effects.

15 Another thing we did was, we looked, in

16 particular, at the Brown's Ferry fire. There have been

17 persistent discussions of whether or not spurious operations

18 did occur during that fire.

19 We, in particular, looked at the spurious -- the

20 reported spurious actuation of two RHR pumps and two core

21 spray pumps.

22 We also looked at the ECCS indicating light

23 behavior that was reported, and the spurious ECCS alarms

24 that were reported.

25 DR. POWERS: Why did you look at these things, in

1 particular?

2 MR. NOWLEN: We looked at the reports of the

3 incident, and these seemed to be the most fruitful set that

4 had promise to teach us something.

5 DR. POWERS: Okay, it wasn't because they looked

6 like they were the most risk-significant?

7 MR. NOWLEN: No. These were the ones that, for

8 example, the spurious operation of the RHR and core spray

9 pumps, we were interested in spurious operations, so we

10 figured we'd learn something from looking at those circuits.

11 What we did find is that the circuit analysis that

12 we performed was able to explain the behaviors that we saw.

13 There is some uncertainty in that, because there is

14 uncertainty as to what the exact circuit configuration in

15 the plant was at the time of the fire, and whether the

16 documentation we have available today is 100 percent

17 accurate in that regard.

18 So you -- in the bottom line, we cannot make a

19 definitive statement, yes, this did happen, or, no, it did

20 not; but our ultimate conclusion is that the most plausible

21 explanation is that there were, indeed, actual system

22 actuations that took place, and that those were likely due

23 to multiple hot shorts, spurious signals in the associated

24 control circuits, relatively simple ones, in fact.

25 So that's what we found on that particular

1 objective.

2 DR. POWERS: I mean, it sounds like it's a very
3 interpretation-dependent result. Have you had the
4 opportunity to share this with other people capable of
5 examining these circuits to see if they agree with your
6 interpretation, or is this still a work in progress, or what
7 is the situation?

8 MR. NOWLEN: Well, the results are published in
9 the report that's been through considerable public scrutiny,
10 and this is not an area where we got any comments back.

11 I guess that's about all I can say.

12 DR. POWERS: But you haven't attempted to share,
13 like, in front of an IEEE society or something like that?

14 MR. NOWLEN: No, not IEEE. We have presented it
15 at the NEI forum on various occasions.

16 Okay, our next objective was to improve the
17 methods and data for estimating the conditional probability
18 of key circuit faults, given cable damage.

19 Primarily, we did this by looking at, again, the
20 available data on cable behavior during fires, and we also
21 looked at some of the events. There is a feedback from the
22 talk that will follow immediately on the major events
23 review.

24 We also looked at how you do circuit analysis, and
25 we reviewed the methods that are typically applied by plants

1 in their Appendix R analyses, and we also looked at a more
2 detailed look of failure modes and effects criticality
3 analysis approach, where you go through in detail and
4 consider combinations of circuit faults, conductor faults,
5 conductors shorting to each other, shorting to other power
6 sources.
7 We also proposed an overall framework for
8 incorporating circuit analysis, advanced methods of circuit
9 analysis into a PRA. The PRA approach includes the various
10 elements you would expect to see, some appropriate screening
11 methods to identify what really needs to be analyzed.
12 The FMECA approach was for the unscreened
13 circuits; quantification of the likelihood and impact of
14 these faults.
15 And then how you fold that into the plant risk
16 models, and, in particular with that, we concluded that
17 there may be a need to adapt the plant models for this
18 purpose.
19 They don't always give you the level of detail
20 that you need to incorporate this type of behavior into the
21 model or into the PRA.
22 DR. APOSTOLAKIS: You're going to talk about this
23 today or some other time? Or is it in the report that's
24 forthcoming?
25 MR. NOWLEN: This framework is proposed in the

1 report. You will notice that we expect to refine it in the
2 followon study of the requantification methods.
3 For example, screening is something that we feel
4 we really need to get in a plant and try this before we can
5 write down exactly how you go through a screening process
6 for this circuit analysis.
7 So we have not been very explicit in how each of
8 these -- the FMECA is fairly well identified. We've laid
9 out an approach, we think, for quantifying the impact and
10 likelihood of these circuits.
11 How we fold it into the plant model and the
12 appropriate screening are the weaker areas at this point
13 that we will expect to address through the requantification
14 studies.
15 DR. POWERS: This screening business always kind
16 of confuses me a little.
17 DR. APOSTOLAKIS: What?
18 DR. POWERS: The screening business confuses me a
19 little bit. I mean, it seems to me that a more satisfying
20 way, though impractically difficult, of course, is to
21 analyze all circuits and then appropriate the sets that you
22 look at based on their probability of occurring.
23 When you screen beforehand, you're making some
24 sort of a judgment about those probabilities, it seems to
25 me.

1 MR. NOWLEN: No, we hope not. In fact, the
2 screening approach would be to say take the worst case, the
3 worst configuration of the circuit, for example, and if it
4 still is not important to risk, then why go further?
5 There may be -- you know, we're reluctant to be
6 putting in -- you know, at this stage, by the time I start
7 throwing in fire frequencies and partitioning factors and
8 fire suppression and things of that nature, in my view,
9 that's into the detailed quantification.
10 DR. POWERS: Okay, so you're doing that.
11 MR. NOWLEN: We're doing more of screening along
12 the lines of a typical PRA that screens out areas because
13 they have no impact on the plant safety.
14 In the same sense, we believe that we can screen
15 out circuits, because we really don't care what they do in a
16 risk perspective.
17 DR. POWERS: You've got an equation with a bunch
18 of parameters that you multiply together?
19 MR. NOWLEN: Not, yet, not at screening, no.
20 DR. POWERS: Not at the screening level.
21 MR. NOWLEN: This is a different level that we
22 perceive.
23 DR. APOSTOLAKIS: Not yet?
24 MR. NOWLEN: Well, eventually, you have to get
25 into the detailed quantification, and, yes, you have to have

1 that equation with all the factors that contribute to the
2 final risk.
3 I'm not sure whether our list is exactly the same,
4 but you have to have an equation at the bottom. You know,
5 at screening, no, not at that stage.
6 DR. POWERS: What he's saying is that this circuit
7 doesn't do anything --
8 DR. APOSTOLAKIS: I --
9 MR. SIU: I just want to interject, by the way,
10 that Steve is referring to requantification studies in his
11 last bullet, and we'll talk about that a little bit later in
12 the presentation as one of our upcoming tasks.
13 MR. NOWLEN: Okay, our next objective was to
14 develop sample estimates of the conditional probability of
15 key circuit fault modes applicable to current operating U.S.
16 nuclear power plants.
17 DR. APOSTOLAKIS: Sample testing? What is sample
18 testing?
19 MR. NOWLEN: Think of it as a --
20 DR. APOSTOLAKIS: Oh, based on a sample.
21 MR. NOWLEN: No, no, no. Just example, if you
22 will, example estimates.
23 Basically, what we came down to here is that there
24 is substantial relevant data. Again, the data that's out
25 there is not ideal by any means. But there is some

1 substantial data out there in certain areas, in particular,
2 but all in all, the data limitations do remain a significant
3 obstacle.
4 We really don't understand this behavior as well
5 as we would like.
6 DR. APOSTOLAKIS: When we say hot short, we
7 usually mean two conductors within the same cable come in
8 contact. Would it be conductors in different cables?
9 MR. NOWLEN: Yes. A hot short -- we defined
10 DR. APOSTOLAKIS: -- same, refer to multiconductor
11 cables. I got that impression.
12 MR. NOWLEN: That's just because that's where all
13 the data is. We don't have any data, per se, on
14 cable-to-cable hot shorts, but my definition of a hot short
15 is a conductor-to-conductor interaction, either within a
16 single cable or between two cables, without a simultaneous
17 involvement of ground.
18 Okay, so, what we found, again, data says that the
19 hot shorts are relatively likely for at least some
20 configurations, but again, these issues that linger are the
21 link between a hot short and a spurious actuation.
22 You know, you have to have specific sets of
23 conductors coming together in a short, or a conductor and an
24 outside conductor. There are specific combinations that
25 lead to the undesired effect.

1 And we don't have data on a lot of the factors
2 that we believe are relevant to this behavior. For example,
3 it was asked this morning, the small fire versus the big
4 fire.
5 I would cast it as is the cable in the flame being
6 flame-broiled, or is it off in the plume being baked like a
7 pizza?
8 You know, I think that's probably an important
9 factor. We don't have data that's very good on those, and
10 there's very little data on cable-to-cable interactions, as
11 I just mentioned.
12 We're coordinating with industry. We're
13 consulting on their test program. They have been very
14 responsive to our comments in terms of adjusting the nature
15 of the tests to address the parameters that we think are
16 most important to go after.
17 And this is also an area where the NRC may get
18 involved with some supplemental testing as well, and there
19 are discussions underway, very, very preliminary discussions
20 underway on that topic.
21 Next was to gain risk insights concerning
22 fire-induced circuit faults, especially those associated
23 with cable hot shorts.
24 I will start right at the bottom. We expect to
25 get the requantification studies to really reinforce this

1 particular objective. In terms of what we did find, the
2 data do appear again. The probability of hot shorts is
3 higher than what we have seen people use in the past.
4 For example, the study that George referenced this
5 morning cited relatively low probabilities of a spurious
6 actuation and again one of the difficulties there is it's a
7 spurious actuation, not just a hot short. We have separated
8 the two, so it is a little difficult to compare and contrast
9 but nominally if that is true that these hot short
10 probabilities are relatively high then it could impact your
11 risk estimates and it could be the perception both in
12 magnitude and the source of where the risk comes from so we
13 still believe this is a very important topic for risk
14 assessment.
15 Another thing that we found is that the quality of
16 Appendix R circuit analysis is a very good PRA starting
17 point. It doesn't give you everything you need for PRA-land
18 but it is a very good starting point and I emphasize a
19 quality PRA.
20 We saw some really outstanding circuit analysis
21 studies done that really give you a lot of good information.
22 DR. APOSTOLAKIS: Where were these done? IEEEs?
23 MR. NOWLEN: No, Appendix R studies as part of the
24 Appendix R compliance documentation.
25 DR. APOSTOLAKIS: Nobody tried to do what you say

1 there?

2 MR. NOWLEN: Not really, not in the IEEEs, no.

3 There were some studies that attempted to do some

4 nominal treatment of circuit analysis spurious actuations

5 and what-not but not at the level that we're contemplating

6 here, no.

7 Then given that you have got a good starting point

8 the FMECA approach does help you flesh out the potential

9 circuit behaviors that you might be interested in, but it is

10 a very burdensome process, frankly, to do the FMECA is very

11 difficult and that is why screening is a very important

12 aspect of what we do.

13 You cannot do a FMECA for every circuit in a

14 plant, not unless you have got the rest of eternity to

15 complete that study. It is a very burdensome, very

16 difficult process to go through so we really need to focus

17 on what is important.

18 DR. POWERS: Can you give me a feel for how much

19 it takes for, say, a typical circuit that you might analyze?

20 MR. NOWLEN: It depends a lot on the complexity of

21 the circuit and the complexity of the cables involved.

22 Seven conductor cables are very common, for example, in

23 control circuits. Our guys were spending on the order of a

24 week or so going through the variations of a seven conductor

25 cable faulting and tracing each of those back through the

1 circuit and understanding all the different combinations of
2 not just two conductors coming together but sometimes it was
3 three conductors or four conductors.
4 There are so many combinations. It can be a lot
5 of work.
6 DR. POWERS: That could take all week. You must
7 work fast.x
8 MR. NOWLEN: Our guys are good, yes.
9 DR. APOSTOLAKIS: Let me understand it --
10 MR. NOWLEN: Thank you for the plug, by the way.
11 DR. APOSTOLAKIS: You have reviewed the literature
12 and so on. When you talk about all these things now, this
13 is background for starting something? I mean a quality
14 circuit analysis is a good PRA starting point. FMECA
15 fleshes out potential circuit behaviors.
16 What does that mean? That you are actually
17 proposing to the Staff to support work in this area next
18 year?
19 MR. NOWLEN: Well, we have done this work already.
20 We have done FMECAs on some example circuits and we will do
21 more as a part of the requantification studies that Nathan
22 will discuss a little later so yes, there is work ongoing
23 and there is work planned in the future.
24 DR. APOSTOLAKIS: So you didn't have the
25 difficulty -- convincing senior managers that this was a

1 risk significant issue that they should spend money on? Did
2 you say you had that problem this morning?
3 MR. NOWLEN: On doing one circuit?
4 DR. APOSTOLAKIS: Yes. That circuit analysis you
5 said the difficulty was you didn't have a smoking gun to
6 convince your management to spend more money on it. On the
7 other hand, you couldn't prove that it was risk significant.
8 MR. NOWLEN: Well, I think the perception again,
9 Nathan mentioned it earlier, the circuit analysis when there
10 was a prioritization exercise done within the NRC Staff as
11 to which of this laundry list of topics do you think is most
12 important, circuit analysis came away far and away the most
13 important topic and so it was a relatively easy conclusion
14 that we better look at that and so we h ave devoted probably
15 more resources to this one task than to anything else we
16 have done.
17 MR. SIU: Yes, if I could comment also. Steve and
18 Company were tasked with looking at improved methods for
19 performing circuit analysis and the response is you don't
20 have to do anything brand new. You don't have to invent a
21 new technology -- use FMECA. It works and we have
22 demonstrated on a few circuits to show what kind of effort
23 it might involve if you go at it directly, if you will,
24 brute force-wise.
25 The concern is of course when you do this for many

1 circuits, many situations, you can quickly run out of money
2 as Steve pointed out, so we are going to have to figure out
3 a way to do it smarter.
4 DR. POWERS: Is it computerizable?
5 MR. SIU: Yes, I would believe so.
6 MR. NOWLEN: Yes.
7 MR. SIU: But we didn't explore that at this
8 point.
9 Again, and I would expect the requantification
10 effort to force us to become smarter in doing things so we
11 can say practically that we can achieve, we can develop the
12 results without spending everything on circuit analysis,
13 because there is a lot of other stuff to do as well.
14 DR. POWERS: Yes, I would just think that this
15 ought to be, if anything, fire protection ought to be
16 computerizable.
17 MR. NOWLEN: Certainly, and for this initial work
18 we didn't have a charter to go in that direction.
19 Another point to raise though is that MOVs have
20 very similar characteristics regardless of which plant you
21 are talking about. There are variations on a theme, but in
22 effect we feel that you can develop a catalog of circuit
23 analysis results over the long-run -- as people do these
24 kinds of studies on different types of circuits, we share,
25 we compile, we in effect develop a catalog and you can begin

1 to thumb through the catalog and say, ah, here, this looks
2 an awful lot like mine but I have got an extra breaker down
3 here, I have got a --
4 DR. POWERS: Well, some of the things that Tom
5 mentioned is his simplified diagrams -- sound very
6 appealing.
7 MR. NOWLEN: Very true. We haven't gone there
8 yet.
9 DR. APOSTOLAKIS: On one of your previous slides
10 you had the objective was to improve understanding of
11 mechanisms. Now you say gain risk insights. We are working
12 now on the research and I was told that anything that
13 improves understanding is out, that understanding is not a
14 criterion anymore. You have to be more specific.
15 DR. POWERS: How did you distill this?
16 DR. APOSTOLAKIS: I got an e-mail from someone.
17 MR. NOWLEN: No --
18 DR. APOSTOLAKIS: I wonder how you managed to get
19 funded to something that would improve understanding. Are
20 these words left over from other times?
21 MR. NOWLEN: No, I think the words --
22 DR. APOSTOLAKIS: The culture these days does not
23 encourage such projects that improve understanding. You
24 have to be specific what you plan to get out of it.
25 MR. CUNNINGHAM: This is Mark Cunningham from the

1 Staff. I think that's fair. As money gets tighter we are
2 trying to be more specific.
3 DR. APOSTOLAKIS: So this is when money was loose.
4 MR. CUNNINGHAM: Looser, shall we say? But part
5 of it, too, is today you have a performance goal for the
6 Agency to improve the realism of our analysis. That is one
7 of the strategic goals of the Agency, so you can either say
8 it is improve our understanding or in today's somewhat
9 different language you want to improve the realism of the
10 fire analysis that we are doing.
11 DR. APOSTOLAKIS: All right.
12 DR. POWERS: Nothing has changed, George, just the
13 buzzwords.
14 MR. NOWLEN: I have a contract. This is what it
15 says.
16 [Laughter.]
17 MR. NOWLEN: Okay. Our last objective was to
18 identify areas where additional work needs to be done to
19 improve our understanding of the risk associated with fire
20 due to circuit faults.
21 Fundamentally we think the data is a severe
22 weakness here. We have some information. It is not ideal.
23 We certainly need more in particular getting at these basic
24 cable mode probabilities -- you know, what is the failure or
25 what is the likelihood that a cable failure will be a hot

1 short failure as opposed to a short to ground?

2 We really don't have a good feel for that in a lot

3 of situations where we would like to have that information.

4 We don't understand what the influence factors are -- you

5 know, how does flame broil versus baking make a difference?

6 Does the size of the cable, does the age of the cable make a

7 difference?

8 There are a number of factors that you can point

9 to, some of which we think are more important than others

10 but our judgments there are still largely qualitative, based

11 on judgment, and so being able to flesh out which of those

12 really are important and which we can safely neglect is

13 important, and then the quantification methods.

14 We have proposed a framework for doing

15 quantification looking at base cases and modifiers so that

16 you would have set of probabilities for a certain set of

17 base cases and modifiers that you would apply to that to get

18 to your specific configuration and fire conditions and that

19 may need to go forward.

20 We have recommended that additional work on that

21 go forward.

22 Cable failures to circuit faults link needs to be

23 quantifiable. Again this gets to some of the things Fred

24 was saying this morning.

25 There has been a lot of confusion in the past and

1 one of the things we have tried to do is clarify language.
2 A hot short is not a spurious actuation. They are two
3 different things.
4 A hot short is a behavior in a cable. A spurious
5 actuation is a behavior in a circuit. They are linked and
6 we need to understand what those links are and be able to
7 quantify that so that we can do it in a PRA.
8 Again we have mentioned the screening methods. We
9 do need to do screening at some level and defining exactly
10 how that goes forward is something we are still working on.
11 The question of the plant models and how suitable
12 they are going to be for this work is also somewhat open.
13 There is some limited followup underway right now.
14 In particular, we are looking at some additional data
15 analysis of some data that cropped up rather late in our
16 study that we didn't have time to analyze fully for the
17 report that's been issued so far and we are going to publish
18 that report as a NUREG CR as well.
19 We are also interacting with industry on the
20 testing and we are discussing the requantification studies
21 with NRC as well, so unless there are additional questions I
22 am going to move on to the next task.
23 The next task is the PRA insights gained from a
24 review of nuclear power plant fire events. Mr. Marty
25 Kazarians was my associate on this particular task, and I

1 would like to acknowledge him, and you will notice that I am
2 now -- ACRS subcommittee, so that's a good thing.
3 DR. APOSTOLAKIS: Progress.
4 MR. NOWLEN: Okay. Our objectives in this
5 particular study were to identify fire risk and PRA insights
6 that we can gain from actual fire events.
7 Initially we had planned on looking at both
8 nuclear and nonnuclear industry data. Ultimately we found
9 enough interesting events in the nuclear industry that we
10 really didn't do any nonnuclear fires so I have narrowed
11 that a little bit to nuclear power plant fire events and
12 then, identify areas for improvement in the fire PRA methods
13 based on the insights that we gain.
14 To do this in effect we asked ourselves three
15 questions of each event -- how do the fires verify or
16 contradict various elements of the fire scenario models that
17 are developed in current fire PRAs; second question was does
18 the actual fire experience lend any insight into the current
19 areas of methodological debate; the third question was do
20 the actual fire incidents indicate the existence of any new
21 phenomena that have not been considered in past fire PRAs.
22 Those were the questions that we were asking
23 ourselves as we went through each event. The events that we
24 selected, initially we basically opened the door to the
25 entire realm of fire events that have happened in the

1 nuclear and nonnuclear industry. We fairly quickly focused
2 in on the nuclear industry and said, well, there's going to
3 be enough there to work with, but we were working from the
4 public databases of EPRI and Sandia, public literature
5 searches and personal contacts.
6 Some of the personal contacts turned out to be our
7 most valuable sources here of getting documents that were
8 not previously available publicly.
9 The events were ultimately chosen based on one of
10 three features of an event and some actually have more than
11 one feature.
12 We had a group of severe fires and this is a
13 classical fire protection perspective -- big fires, bad
14 fires, fires that were very severe from a classical
15 perspective.
16 The second group was challenging fires, and this
17 is the nuclear safety perspective, those fires that led to a
18 challenge to your nuclear safety.
19 The third category were just interesting fires.
20 They illustrate some unique behavior or had some information
21 to lend on a particular area of debate, for example, and
22 again there is some overlap between these and I will get
23 into that a bit.
24 We ended up with a list of 25 events and this is
25 the list. It is a laundry list of large fires. As you

1 notice there's a number of fires that did not occur in the
2 U.S. We have a number of former Soviet reactors on the
3 list -- Maanshan, Narora, Vandellos as well.
4 The Soviet designed Griefswald, Beloyarsk,
5 Armenia, South Ukraine, Zaporozhye, Kalinin, Ignalina,
6 Chernobyl 2.
7 It is a fairly wide list here.
8 DR. APOSTOLAKIS: When did Appendix R become
9 public?
10 MR. NOWLEN: 1979. In 1981 it was official. I
11 think initial comments were '79.
12 DR. APOSTOLAKIS: If I look at this list, can I
13 say that that was a successful piece of regulation?
14 MR. NOWLEN: Absolutely and we will say that in
15 just a few slides.
16 DR. APOSTOLAKIS: So what is unsuccessful? You
17 have 100 of those?
18 MR. NOWLEN: Success is we have not yet had core
19 damage due to a fire, in my view.
20 If you will bear with me, I am going to get into
21 that specifically.
22 DR. APOSTOLAKIS: What is it that prompted
23 Appendix R? Browns Ferry?
24 MR. NOWLEN: Browns Ferry.
25 DR. APOSTOLAKIS: Did we have core damage there?

1 MR. NOWLEN: No.

2 DR. APOSTOLAKIS: No. Therefore, Appendix R was
3 established, promulgated to make sure that we don't have
4 similar things in the future. The fact that we haven't had
5 core damage is not really a sign of success of the appendix.

6 MR. NOWLEN: Yes, that's true. There are other
7 ways of looking at this as well.

8 For example, I would offer this. For the U.S.
9 industry the most challenging fire we have ever faced is
10 Browns Ferry. We have not actually had a seriously
11 challenging fire since and of the events on that list the
12 only challenging fire in the U.S. is Browns Ferry.

13 Now I am jumping ahead a bit but there were a
14 number of challenging fires in the international community.
15 In total we had five international fires that we called
16 challenging so I would say that is a success.

17 Another success is if you compare some of the
18 fires that took place in foreign reactors as compared to the
19 fires that have occurred in the U.S., the severe fires are
20 much more severe in for example the Soviet design reactors.
21 They have had some really severe fires. I will get into
22 that in a bit.

23 I think I was probably a little flip in saying
24 that particular --

25 DR. APOSTOLAKIS: Another way to look at the

1 foreign fires, would you have a reasonable assurance that
2 these could not have occurred here because of Appendix R?
3 MR. NOWLEN: There are specific features of some
4 of these events that, yes, we don't feel are applicable to
5 U.S. plants in large part because of Appendix R.
6 MR. SIU: Yes. Let me comment that Steve was not
7 asked to look at that specifically. He was looking at this
8 from a fire PRA standpoint to say are there scenarios that
9 we should be considering in our analyses, so while he does
10 have a number of comments in the report on the fire safety
11 lessons learned that was not the thrust of the report, so we
12 didn't ask him in particular to look at the question that
13 you are raising, whether there is any implication with
14 respect to the effectiveness of Appendix R.
15 MR. NOWLEN: Okay. We gained insights in a range
16 of areas -- it covers the spectrum of what PRAs attempt to
17 quantify. Due to the time constraints I am just going to go
18 through some of the samples of the ones that I think are
19 more interesting.
20 One that we did reach is sort of an overall global
21 conclusion that nothing we saw fundamentally challenged the
22 overall framework of a quality fire PRA.
23 There was nothing that just inherently fell so far
24 outside the scope that you could not adjust the methods to
25 address that.

1 Some elements of some of the events would not be
2 captured in a typical fire PRA as currently practiced. Some
3 aspects were shown to be conservative and one thing that we
4 did see is the importance of considering a range of fires --
5 that is, from the small fires to the very large, long
6 duration fires. They do occur with some nontrivial
7 frequency.
8 DR. APOSTOLAKIS: And PRAs don't do that well?
9 MR. NOWLEN: This was related to the IPEEEs. Many
10 of the IPEEEs were point estimates based on the most common
11 fire or the most likely fire.
12 Here is the six challenging fires that I
13 mentioned.
14 Browns Ferry -- again the only such fire that we
15 have had in the U.S..
16 Narora -- in our view this is arguably the most
17 severe fire that or the most challenging fire that the
18 nuclear industry worldwide has seen. This was a turbine
19 building fire, lasted approximately 9 hours, the fire
20 itself.
21 There was a 17 hour station blackout. Loss of
22 power to both of the main control rooms. When one of the
23 units abandoned the main control room and went into remote
24 shutdown they had also no power at the remote shutdown
25 station either, so they were in a pretty severely degraded

1 situation.

2 Again ultimately in that case they relied on a

3 diesel-driven fire pump to provide makeup flow to the

4 reactor and that basically what kept them out of trouble.

5 Greifswald, Armenia, Beloyarsk, Chernobyl -- these

6 are all Soviet-designed reactors and I number of these were

7 quite severe fires in addition to being challenging.

8 Griefswald was a cable switchgear fire with a

9 station blackout and they had a stuck-open PORV that

10 aggravated their situation.

11 Armenia, another cable fire. This actually

12 involved two cable galleries and they basically lost all of

13 their active core cooling systems for some period of time.

14 Beloyarsk was a turbine building oil fire and this

15 was quite severe. The turbine building roof over where the

16 fire occurred collapsed within a few minutes of the initial

17 fire starting and ultimately the fire propagated to and

18 through most of the control building including some fire

19 spread into the main control room.

20 Chernobyl was another turbine building fire and,

21 you know, similar in nature. It didn't spread quite as far.

22 One of the things we saw contributing in

23 particular to the Soviet design reactors was an apparent

24 poor attention to detail on their fire barriers. These

25 fires were able to propagate past nominally fire walls

1 through open penetrations, open doorways, open hatches, with
2 relative ease and spread quite rapidly so that is one
3 element where I think the U.S. can clearly argue we are in a
4 much better position because of the attention to detail of
5 fire barriers and penetration seals that we have.
6 I think one thing that we commonly find in PRAs is
7 the idea of a big fire versus the challenging fire. The
8 studies did confirm that not all big fires are challenging
9 and not all challenging fires are big and some fires are
10 both big and challenging.
11 Examples are given here. The turbine building
12 fires -- there have been a number of fairly severe turbine
13 building fires. They really haven't challenged nuclear
14 safety significantly. Example is Vandellos. The plant
15 never restarted after the fire but really in terms of
16 nuclear safety challenge it wasn't that severe of a
17 challenge.
18 The challenging fires that are not especially
19 big -- Browns Ferry from a classical perspective of fire
20 protection was not that severe a fire. It was relatively
21 confined to a small part of the plant. There was no
22 structural damage.
23 It is arguably the largest cable fire we have ever
24 had in the U.S. clearly, but really from a classical
25 standpoint it wasn't all that severe.

1 DR. APOSTOLAKIS: You said earlier though that
2 what you saw did not challenge fundamentally the raw
3 framework of a quality fire PRA.
4 MR. NOWLEN: Yes --
5 DR. APOSTOLAKIS: Are there PRAs that have the
6 kind of fire Browns Ferry had? Normally you don't consider
7 things like that, that in the penetration itself you start a
8 fire.
9 MR. NOWLEN: Well, in this case the significant
10 part of the fire was the fire on the other side of the wall
11 in the reactor building, the fire in the cable spreading
12 room really didn't have much independent contribution.
13 DR. APOSTOLAKIS: It started in the wall.
14 MR. NOWLEN: it started there.
15 DR. APOSTOLAKIS: If I did a fire PRA today, I
16 would probably have to postulate some fire in the room.
17 MR. NOWLEN: Correct. We would call it a
18 transient fire.
19 DR. APOSTOLAKIS: Would it go into this, or are we
20 missing a particular failure mode that was weird but I don't
21 know that postulating a fire in a room would really
22 reproduce the Browns Ferry stuff, and the fact that those
23 cables were in penetrations but they spread to outside -- it
24 could be a critical location.
25 MR. NOWLEN: Oh, absolutely, yes. Absolutely.

1 DR. APOSTOLAKIS: Why?

2 MR. NOWLEN: Because of the concentration of
3 cables that were in that particular location going through
4 the wall between the reactor building and the cable
5 spreading room. You would have clearly gone in and said look
6 at all the cables over here.

7 DR. APOSTOLAKIS: So you would put a fire near the
8 wall underneath those cables?

9 MR. NOWLEN: Right, or postulate a self-ignited
10 cable fire there. I probably would not have postulated the
11 guy with the candle starting the fire.

12 DR. APOSTOLAKIS: No, no, no -- you wouldn't have
13 to. He probably had a lighter this time.

14 [Laughter.]

15 MR. NOWLEN: Or he would have a smoke generator
16 that flamed.

17 DR. APOSTOLAKIS: But if you think that there is a
18 reasonable chance of somebody doing a quality fire PRA that
19 would identify the location of a place of fire there, then I
20 think --

21 MR. NOWLEN: Yes, I think those clearly. A good
22 cable routing study would have identified that as a critical
23 plant location. Whether there would have been a specific
24 ignition source there that they might have argued, well, I
25 don't have anything here that can cause the damage but

1 nonetheless it would have been analyzed in a PRA.

2 MR. SIU: We have examples of studies clearly that

3 identify those kinds of location as being important, and as

4 Steve said, you either postulate a transient fire or a

5 self-ignited cable fire.

6 You might argue about the frequency assigned to

7 that. That is not -- we are not saying that is a structural

8 problem with the PRA.

9 MR. NOWLEN: Right. This is another one that

10 we've touched on all day, circuit faults. And Dana has

11 asked the questions several times about do we have a good

12 database on circuit faults and behaviors. I will answer

13 that question, no, we don't. The test data that we have, as

14 I've mentioned before, is not ideal. There is some limited

15 evidence from the fire events, and I think that, in fact,

16 this particular study has brought out some fire events that

17 no one really was aware of before in circuit fault aspects

18 of those events that we think were very interesting.

19 One example is Armenia, and this is a case where a

20 fire induced cable fault spuriously reconnected the

21 generator set to the off site power grid after the plant had

22 tripped. This caused the generator to act like a motor, and

23 it rotated in an asynchronous mode, and there was -- it

24 actually exploded and caused a secondary fire at the

25 location of the generator.

1 There was also a diesel generator that started up
2 to take up the loss of off-site power load that resulted
3 from that, and due to control cable faults, which the
4 Armenians tracked down, they decided it was their control
5 cables; that they had -- the control cables had faulted and
6 had caused the diesel generator to trip out, and they were
7 unable to recover that fault.
8 There was also a hot short, that was their
9 terminology -- they use that word -- that spuriously started
10 one of the feed water pumps, and there were a number of
11 instrument readings that were skewed by fire damage to the
12 cable, again in the language used by the Armenians in their
13 report.
14 DR. POWERS: Steve, let me ask a question.
15 MR. NOWLEN: Yes.
16 DR. POWERS: If we don't have a good database, but
17 we got some data here. Do we have a database from these
18 various events that would allow us to test the adequacy of
19 the design of a test fire?
20 That is, I can imagine an experiment in which I am
21 going to test like a seven conductor cable. And I know from
22 these events that a seven conductor cable exposed to a fire
23 did a bunch of things. Could I then test my test set up to
24 see if it caused a seven conductor cable to do a bunch of
25 things, the right bunch of things, to say, okay, now, this

1 test set up is good for testing other things and be
2 reasonably protypic?
3 MR. NOWLEN: I'd love to say yes, but in my gut I
4 have to say no. The problem is that attempting to reproduce
5 the behaviors that took place in a real fire with a test is
6 incredibly difficult. It was attempted, for example, in the
7 Bonds Ferry case. There were tests attempted to reproduce
8 the behavior of that fire, and it did not work. It didn't
9 work well at all. They could not reproduce that behavior.
10 So, fundamentally--
11 DR. POWERS: If that's the case--
12 MR. NOWLEN: I have to say it's going to be very
13 difficult to try and take some specific configuration that
14 was observed in particular fire and try and reproduce that
15 behavior with any confidence in the laboratory. Our
16 recommendation has been to rather than trying to reproduce
17 any one case, to try and reproduce and understand the
18 fundamental behaviors that are taking place and build models
19 that then can address those fundamental behaviors.
20 DR. POWERS: But if I can't reproduce things that
21 are observed, then haven't I passed from the realm of
22 science into the realm of metaphysics?
23 MR. NOWLEN: To I really have to answer that?
24 DR. POWERS: No, I was just--
25 MR. NOWLEN: I -- well, again, I think it's more

1 consistent with the PRA approach is to develop models of
2 these--
3 DR. POWERS: Well, that is metaphysics.
4 MR. NOWLEN: Physical behaviors, to understand the
5 underlying physical behaviors and address them to the extent
6 you can. You know, again, one of the problems with fires
7 like this, for example, the Armenians went through a lot of
8 work to figure out what happened here. And it's often very,
9 very difficult, in a post mortem, to understand exactly what
10 happened in a fire. We found that clearly with Browns
11 Ferry.
12 DR. POWERS: It burns up the evidence.
13 MR. NOWLEN: It burns up the evidence. It does.
14 To a certain extent, it does, and it's very difficult.
15 MR. SIU: I think the intent certainly is not to
16 reproduce exactly the characteristics of a fire that you
17 observe, as long as you're getting somewhere in the envelope
18 if you will. I mean, I don't have to know that in a
19 particular cable tray fire that this particular time it took
20 three minutes to cause a particular fault, and seven minutes
21 later a different fault.
22 DR. POWERS: Yeah, but I'm asking for more
23 qualitative.
24 MR. SIU: Yeah, and--
25 DR. POWERS: That I got those kinds of faults

1 would be what I would be asking.

2 MR. SIU: Right, and what you're seeing, of

3 course, is that, yes, you can get those faults, and yes, we

4 think that, based on our understanding of circuit failures,

5 you can see these faults. We're trying to come up with and

6 identify with improved understanding the particular factors

7 that affect the likelihood of these faults. So, you know,

8 we've postulated a number of things in the report or Sandia

9 has that says, for example, perhaps the location of the

10 cable bundle within the try is important. Or perhaps the

11 degree of exposure is important, and there are physical

12 mechanisms that would justify identifying those factors as

13 opposed to other, any arbitrary set of factors you can dream

14 up.

15 And I think you can get tests, so, again, we

16 provided NEI with comments trying to make sure that some of

17 these issues are being addressed in the tests so we can get

18 some sense as to whether these factors make any difference.

19 It won't be definitive, but it would be -- increase our

20 understanding to the point where you might make better

21 plausibility arguments, and I think that's where we are

22 right now.

23 MR. SIEBER: Question.

24 MR. NOWLEN: Yes.

25 MR. SIEBER: In your event review, did you find

1 any instances where this multiple high impedance fault
2 occurred?
3 MR. NOWLEN: No evidence one way or the other, no.
4 We saw no discussion of that -- of that kind of behavior at
5 all.
6 MR. SIEBER: Alright.
7 MR. NOWLEN: We didn't especially look for it, but
8 in the events that we reviewed, we did look for any evidence
9 of that, and there was just no discussion one way or the
10 other.
11 This was a second circuit fault case that was kind
12 of interesting. This was Ignalina. In this case, it was an
13 oil pressure instrument cable that was damaged due to the
14 fire, and it caused on of the main coolant pumps to trip.
15 That is, this pump had an interlock with its oil pressure
16 system, and when the oil pressure read low, it tripped the
17 pump out, and they attempted to overcome that failure, and
18 were unsuccessful. There was also an instrument and control
19 cable fault that led to spurious opening of two normal and
20 two essential 6 KV supply buses. And there was another
21 cable fault that was attributed with having tripped out a
22 transformer designed to take up the loads from these lost 6
23 KV buses. So there were kind of a cascading effect of a few
24 things.
25 DR. POWERS: It just reinforces the anthropomology

1 of fires. They're insidious.

2 MR. NOWLEN: They are. That's true. That's very
3 true. A couple more quick cases. Waterford is -- we didn't
4 dig into this one very deeply, but there were some erratic
5 indications record related to an auxiliary transformer, and
6 the cables for that transformer were, in fact, involved in
7 the fire. There's no actual confirmation of any spurious
8 actuations or anything, but there were some indications of
9 some interesting circuit behaviors there. And we've already
10 talked about the Browns Ferry study and -- regarding what we
11 found there. So I'll skip over that one.

12 The last one I'll point out. It was kind of an
13 interesting case. This was a bit of a reversal. In this
14 case, there was a cable that failed, and the plant was going
15 through start up, and they tripped due to a steam leak. And
16 there was a conductor, the conductor fault on a
17 multi-conductor cable underneath the turbine generator set
18 that spuriously reconnected the generator back to the grid,
19 kind of like the other one that I mentioned. And, in this
20 case, the generator acted like a motor again, the rotor
21 failed, and we had a quite severe turbine building fire that
22 ensued from that event. So this was a little bit of an
23 unusual one where a circuit fault led to a fire as opposed
24 to a fire leading to a circuit fault. So that was kind of
25 an interesting case.

1 Another area that we found some rather interesting
2 insights was in the human actions, human recovery area. In
3 general, we found that there were actions taken in a number
4 of these events that would not have been credited in a
5 typical PRA. For example, you know, the idea that the
6 operators will go the extra mile to recover their plant.
7 There were a number of cases where there were actions not in
8 the procedures, for example, in the case of the Soviet
9 reactors. Their design is such that they have many, many
10 hours where they can just passively cool the reactor before
11 they get in too deep. And, in those cases, they were able
12 to reroute new power cables to bypass areas that had been
13 fire damaged where they had lost all of their power feed
14 cables. They were actually running cables from their diesel
15 generators out to specific pumps and motors to restart them.
16 We would not typically credit that in a PRA. I mean, if
17 it's not proceduralized, there's nothing staged there. We
18 would typically not credit that.
19 In the Vandellos case in particular, there was
20 number of areas where the operators wearing self-contained
21 breathing apparatus went through flooded areas of the plant
22 to access manual actions and were successful at doing that.
23 We also saw some cases where they actually diagnosed a fire
24 based on the funny things going on on the control board.
25 There was one case in particular involving a containment

1 fire that they diagnosed because the pressure in the
2 containment was rising up, and they said, it must be a fire.
3 Interesting.
4 We did also see cases where the fire did prevent
5 or degrade the manual actions. There was smoke and heat
6 preventing actions. There was actually some of that in the
7 Browns Ferry fire, where they attempted to take some manual
8 actions and were driven back by smoke. And smoke and
9 confusion leading to errors.
10 There was some cases involving smoke in the main
11 control room in particular that were attributed with having
12 complicated the operator response.
13 We also saw, you know, a continuing reluctance to
14 apply water on electrical fires. That's still a very
15 prevalent attitude in the industry, worldwide, by the way.
16 When we get to the areas where you might argue
17 there are gaps in our PRAs, this is one. Multiple fires.
18 We saw, out of the 25 events there were nine that involved
19 either simultaneous fires that occurred from a common cause
20 or a secondary fire, where an initial fire occurred. Damage
21 from that fire led to a secondary fire in another part of
22 the plant. This typically was due to common electrical
23 connections. For example, Ignalina was a cable fire that
24 ignited at several place in two separate cable galleries,
25 and propagated from there. A case -- example -- in the U.S.

1 was the Palo Verde incident, where there was a transformer
2 -- small transformer that had a fault, and there was a small
3 fire ignited at the location of the transformer, and a
4 secondary small fire, second simultaneous small fire, in the
5 control room.
6 So, in total, there were nine cases of that out of
7 the 25 events that we reviewed. I don't have time to do
8 statistics on that particular sample or anything.
9 We don't treat multiple fires. We treat one fire
10 at a time. The risk significance of this is clearly still
11 undetermined, and we didn't -- that wasn't our charter. You
12 know, the obvious questions to ask is how frequent are such
13 events, and do they introduce any new risk scenarios. In
14 our view, the PRA framework could be adjusted to address
15 multiple fires, but we need a basis as to say, should we,
16 first of all. Is there a good reason to do this? And then
17 if we should, then the question is, well, when, where, why,
18 how do we decide when we might get multiple fires in the
19 plant.
20 DR. POWERS: Does the current PRA framework treat
21 accident initiators of other types causing fires?
22 MR. NOWLEN: Not especially, and, in fact, another
23 of gap was multiple initiators. We did see this in some
24 cases where, for example, fire combined with flooding.
25 Vandellos had that. The fire caused damage to a flexible

1 boot on a sea water pipe and flooded out parts of the
2 reactor and auxiliary building. Turbine blade ejection with
3 explosion and fire--that's sort of the one that you're
4 looking at. There has been cases of that. So, yeah, and
5 this is another gap, if you will, in the way we do PRAs. We
6 don't postulate multiple initiators. Fires occur
7 independent of other types of events. Again, whether it's
8 risk significant or not remains indeterminate. We, again,
9 fundamentally feel that the framework of a PRA could address
10 these things if we had a basis for saying that we needed to
11 address it and for saying where, when, why--the same
12 question. One issue that we would have to get at in
13 specific with fire is that we don't trace all the cables
14 that might find yourself interested in if you start
15 postulating these kinds of things.
16 For example, flooding the sump pumps would not
17 typically be traced in a fire PRA, because they're not that
18 important to us, we assume. And in the case of Vandellos,
19 some of the sump pumps failed because of fire damage so that
20 was an aggravating factor in that event.
21 Another interesting thing that came up was the
22 loss of the fire protection systems due to a fire. There
23 were events where the fire actually damaged the system
24 before it was able to operate. In the U.S., the standards
25 are generally mute on how you route your power and control

1 cables in particular for the fire protection systems. The
2 fire pump standard appears to be the one exception to that
3 where the pump standard actually does say you need to route
4 your cables in an independent way. And in a fire PRA, we
5 typically do not trace those fire protection system cables,
6 so, again, this would be -- you know, inherently we're
7 assuming that they're independent and in the future we may
8 want to verify that assumption rather than simply making it.
9 And in summary, again, the overall structure of a
10 quality fire PRA we really don't think was brought into
11 question by anything we saw in these events. There are
12 gaps. The multiple concurrent fires and the multiple
13 initiating events are probably the most notable of those.
14 And we believe that there are some elements of a fire PRA
15 that may deserve more attention than are typically given in
16 fire PRA. This is partly perception, preconceived notions
17 of what's important and what's not. For example, the severe
18 turbine hall fires, there were cases where these several
19 turbine hall fires did, in fact, lead to challenging nuclear
20 safety. We've seen that in some of the IPEEEs as well, but
21 a lot of PRA studies will dismiss the turbine hall fairly
22 early in the study and we think there may be a basis for
23 arguing that you should take a little more attention there.
24 Long duration fires in general. A number of these
25 fires were quite long, and typically fire PRAs will not

1 postulate these long duration fires, you know, several hours
2 in length. They may be low probability, but if the
3 consequences are high, they could still be risk important.
4 So a little more attention to detail in that regard.
5 And human factors in firefighting. Again, we saw
6 human factors playing a role. Reluctance to apply water,
7 for example. Operators taking actions that we wouldn't
8 normally credit. Firefighters insisting on electrical
9 equipment being deenergized before they apply water to it.
10 We saw one case where they called up to the
11 control room and said, well, turn off pump B, because we
12 need to spray water on it. And so the operators turned off
13 pump A, and now they had lost pump B to the fire and pump A
14 because of a manual action. Those kinds of things we don't
15 typically deal with very well in our current fire PRA.
16 Probably more attention is deserved.
17 And that concludes my presentation.
18 DR. POWERS: You gained a tremendous amount, it
19 sounds to me, from looking at these NPP fires. Do you think
20 you've exhausted it, or would it be worthwhile now to go on
21 and look at other industrial fires? I mean, you--
22 MR. NOWLEN: We learned a lot in these fires, and
23 I'm not sure that the non-nuclear data is going to give you
24 a lot more.
25 DR. POWERS: I mean, you assume that the data

1 quality is not going to be any better.

2 MR. NOWLEN: It's probably going to be worse. We
3 get better documentation of the fires that occur in the
4 nuclear industry than we do of typical industrial fires. I
5 think you also face the dilemma of applying the non-nuclear
6 large industrial data to a nuclear power plant. There are
7 numerous substantial differences that argue they're not
8 going to be the same. So I would argue that you're
9 potential benefit is probably quite limited.

10 MR. SIU: Yeah, it is useful to point out -- we do
11 have a task ongoing now where we are looking at industrial
12 fire experience. And it's not necessarily from the
13 standpoint of a big dramatic fire, or even, obviously,
14 you're not worried about safety challenges, but if you're
15 trying to learn something about switch gear fires, for
16 example, then you would expect that you could get something
17 out of that. And so there is a task on the books. We have
18 some difficulties now with getting that task being
19 accomplished because of things that are outside of our
20 control, but it's there right now.

21 Okay, if I could then, I'll just pick up and talk
22 about where we're going on this program.

23 Again, and Steve has talked about some of the
24 things that we've been learning over the last year or so.
25 In that same time period, a number of things have happened

1 that would have told us that we need to revise our initial
2 plan for conducting the research, not the least of which the
3 plan--initial plan was covering fiscal years 1998 through
4 2000, so obviously we need a new plan anyway. But we also,
5 of course, have to account for a number of activities going
6 on in the agency and industry, and I've listed a number of
7 the events that have occurred since we issued our plan. We
8 have issued a risk informed performance-based fire
9 protection rulemaking plan, and that was earlier this year.
10 Of course, NFPA 805 has been put together and has -- you'll
11 hear about that later on today.
12 You know, mention was made of the fire
13 significance determination process. That's been put
14 together. And obviously ,the questions have arisen that
15 could be addressed by the research program. We heard, again
16 this morning, about the industry effort to develop a risk
17 informed approach to resolve circuit analysis issues.
18 We, of course, pay careful attention to the ACRS
19 reviews of the research program and some of the points made
20 in those reviews that were -- would tell us that again we
21 need to update our plans. We've just heard a discussion of
22 the research results obtained. In addition, we're getting
23 input from the user offices, both NRR and NMSS on potential
24 fire protection research needs both for reactor and
25 non-reactor applications. A number of cooperative

1 activities have been established since we put the plan
2 together. We have a memorandum of understanding with EPRI
3 in fire risk assessment. We have an international program
4 on fire modeling that Dr. Monty Day is leading up and doing
5 some work in.
6 And we have activities ongoing within the OECD and
7 within COOPRA, in particular with the WG RISK, that's the
8 working group on risk activity. There is a start up
9 developing a fire database for -- primarily looking at
10 things that would be of interest in fire modeling. I don't
11 know that they have completely ruled out operational kinds
12 of data yet in terms of initiating events, but I'm not --
13 that's something that we're going to be participating in.
14 DR. POWERS: Well, is it a fire frequency or is a
15 fire consequence modeling?
16 MR. SIU: It's primarily fire consequence, and
17 that's -- you're looking at the properties of components,
18 things that would also help you with fire modeling.
19 DR. POWERS: Because there's a -- I mean, it seems
20 like fire frequency databases have proliferated like weeds.
21 And it's also been questionable to me on whether frequency
22 data from non-U.S. plants would be transferrable to U.S.
23 plants.
24 MR. SIU: It's a good question. We're making no
25 attempt to do that at this point. We are planning on -- as

1 you, I believe are aware, NEIL, Nuclear Electric Insurance
2 Limited, is putting together a database on fire events
3 that's going to be hopefully more complete than what we have
4 now because of the reporting criteria that they employ. So
5 that would give us a more complete set of events. And we
6 actually have some folks working within the OAREB, Operating
7 Events Risk Analysis Branch in research, looking at that
8 database and putting it together with data from component
9 failure events associated with fires and creating a database
10 that we can use to -- in house certainly.
11 DR. POWERS: Well, what do you do on the frequency
12 issues? You got very frequent fires that are little.
13 Somewhat less frequent fires that are middle and
14 acknowledging what Steve said about big doesn't necessarily
15 mean challenging.
16 MR. SIU: Right.
17 DR. POWERS: But for moment, let's assume that
18 size is closely related to challenging. But you got zip on
19 big. You got one data point sitting out there, Browns
20 Ferry. Arguably, it will never occur because of appendix
21 aura and what not. So in the end, for PRA purposes, you're
22 forced to extrapolate to the big fires.
23 MR. SIU: Well, I guess I wouldn't characterize it
24 quite that way. Once you take the approach that we
25 typically employ in most fire PRAs, where you're looking at

1 specific sources. You're not just talking about big in an
2 abstract sense, like a megawatt or 500 kilowatts or
3 whatever. You're saying, okay, I've got a particular
4 source, and maybe it's a switch gear cabinet. And do I have
5 information on switch gear cabinet fires? Well, yes,
6 actually we have some information on them from experiments.
7 Could we have more data? Yeah, we probably need more
8 information. People are modeling the effect of oxygen
9 starvation, for example, and whether that puts a real limit
10 on the size of the fire you can have within the cabinet.
11 But there are things you can do once you start breaking down
12 the problem into specific scenarios. The reason I put this
13 slide up here, we are looking at a number of specific
14 scenarios, like switch gear fires, transformer fires, and
15 then we've got this thing right here. The frequency of
16 challenging fires. This is the activity that says, well,
17 gee, we've lived with the severity factor approach for -- I
18 guess it's been -- yeah, 20 years now, can we do better?
19 Maybe not, given the information we've got available, but
20 we're going to try. And we've got an activity ongoing where
21 we're trying to look at some of the scenarios leading to the
22 fire, if you will the pre-initiation scenarios, getting a
23 little bit more mechanistic about how we deal with these
24 rather than just treating them purely statistically.
25 Obviously, there will be modeling involved. Obviously,

1 there will be some subjective opinion involved, but we're
2 trying to see if doing that will shed any more light on
3 this, and it actually might shed some light on the scenarios
4 that Steve was talking about when you start talking about
5 multiple fires. If you get down to a more of a causal
6 representation, then maybe you start seeing where you have
7 to worry about these things and maybe not. This is a
8 somewhat risky task for us. We understand that we may not
9 succeed here, because of the data limitations. But we're
10 taking shot.
11 DR. POWERS: When you look at what your senior
12 reactor analysts have for risk analysis tools, what do they
13 have for fire?
14 MR. SIU: They typically don't have the fire.
15 What they're faced with, of course, is an analysis somebody
16 else has performed, and they have to understand what are the
17 limitations in that analysis. Obviously, they don't want to
18 take things at face value, and they need to understand
19 what's the basis for a particular approach. Where are the
20 weaknesses. We have not at this point given them great
21 guidance, and that's one of the things that we will address.
22 DR. POWERS: They've told me.
23 MR. SIU: Yes.
24 DR. POWERS: Over and over again. They're crying
25 for something.

1 MR. SIU: Yes.

2 DR. POWERS: Because they don't even really have
3 five technology available to them.

4 MR. SIU: Right. Sorry. So that's one of the
5 things that we clearly need to address and I think you'll
6 see that a little bit later, and we're trying to get at
7 that.

8 The last event I wanted to mention, which I
9 believe the subcommittee is probably not familiar with --
10 there has been a fire research coordinating committee
11 established -- that's to coordinate -- involves primarily
12 branch chiefs within NRR, both fire protection and PRA. Of
13 course, research--

14 DR. POWERS: Do you have anybody on this that's
15 just representing the senior reactor analysts?

16 MR. SIU: No, we don't.

17 DR. POWERS: I mean, these guys -- the guys that
18 are on the line that are doing this sort of stuff, and
19 they're looking at analyses, I mean, at least when I chat
20 with them. You know, it takes about a half an hour of
21 conversation before they're saying, you know, I just don't
22 have anything, and I get asked questions about this stuff.
23 I mean, it seems to me like they ought to have a voice on
24 that. I mean, they seem to be very important to the agency.

25 MR. SIU: Yeah. Yeah, that's correct. At least

1 at the current way we're approaching this, when we put the
2 plan together, this revised plan, and it will have certainly
3 the targets and objectives for each task that we have in
4 there, and it will be circulated for review and approval
5 through the agency, and I would hope that they would come at
6 least through that mechanism. We're also trying to -- if we
7 -- let's see if I address this a little bit later.
8 DR. POWERS: I wish you could go reach out to
9 them, because I get some fairly impassioned appeals on this.
10 MR. SIU: Yes, we -- one of the things that we
11 did, and it may not be in my viewgraphs here, so I'll just
12 cover that now -- taking the subcommittee's -- the ACRS'
13 overall comments on the program to heart, again, you were
14 right, we didn't have the direct linkage to some of the
15 folks who were actually using these tools. And so we added
16 what we called communication plan where we're not just
17 creating reports, but also trying to reach out, as you said,
18 and provide the guidance in alternate forms, and we don't
19 know exactly what's that going to take, whether it's going
20 to be workshops or additional training courses or what, but
21 there's every intent to provide the research results in
22 forms that can be used much more quickly and efficiently.
23 So again, you'll see in the updated plan, this
24 communications plan and it tries to accommodate some of
25 these ideas.

1 Okay. There is a draft plan that is being
2 developed. It's pretty close to being issued for review
3 through the agency, and just here, I'm showing you what are
4 the elements in that draft plan. And obviously, the usual
5 stuff that you would expect--the objectives and the
6 background. We do try to provide a much more explicit
7 discussion of what are the outputs of the program and the
8 regulatory uses of those outputs and what's the relationship
9 with other programs and activities. So, obviously, there's
10 a lot of stuff going on in fire throughout the NRC. And we
11 try to draw those relationships with what we're doing.
12 Of course, we talk about the technical objectives,
13 tasks, and milestones, and then at the end I mention this
14 communications plan. We say both what it is we're planning
15 -- what's our planning process and then how will we
16 disseminate the results of research. And that's hopefully
17 pretty close to being issued.
18 Just give you an indication of the kinds of
19 objectives here, and we have still this old words -- improve
20 the understanding--
21 DR. POWERS: There's nothing bad about that, by
22 the way.
23 MR. SIU: I personally don't think so myself.
24 DR. POWERS: Well, I don't either.
25 DR. APOSTOLAKIS: You don't think -- do things

1 just to understand something.

2 MR. SIU: And the point is, of course, we're--

3 DR. APOSTOLAKIS: And he wants to have -- improve

4 qualitative understanding.

5 MR. SIU: Yes, that's right.

6 DR. APOSTOLAKIS: Soften it as much as you can.

7 MR. SIU: Well, that has to do, of course, with

8 ranking results and so forth--

9 DR. APOSTOLAKIS: Yeah.

10 MR. SIU: As well as the CDF results. But we do

11 -- the smaller text there refers to more specific objectives

12 that we have that we think we can accomplish with the

13 revised plan, so we actually want to apply the methods,

14 tools and data that we've developed during the research

15 program to date in a requantification study, and I'll talk

16 about that in a couple of slides.

17 DR. APOSTOLAKIS: You don't plan to develop a

18 substitute for cold burn, do you? At this stage?

19 MR. SIU: No, at this stage, no.

20 DR. APOSTOLAKIS: Okay.

21 MR. SIU: We certainly need to better understand

22 the limitations and uncertainties with all the fire models

23 that people are using, so there's a task underway to look at

24 CFAS. There's a task underway to look at the fire dynamic

25 simulator, which is the NIST computational fluid dynamics

1 code.

2 DR. APOSTOLAKIS: There are French codes, I

3 suppose.

4 MR. SIU: Well, in the cooperative effort, this

5 thing I mentioned very briefly, a number of interested

6 parties are involved, looking at their own models. So the

7 French, of course, are involved, using their own models.

8 The Germans are involved, using their own models. The U.K.

9 is involved, using their own models, and so forth.

10 DR. APOSTOLAKIS: But I read your report you wrote

11 for some other people, for the survey of international

12 activities, didn't you write that?

13 MR. SIU: Participated in that, yes.

14 DR. APOSTOLAKIS: Yeah. I thought it was awful.

15 Not the report, the situation.

16 MR. SIU: Oh.

17 DR. APOSTOLAKIS: I mean, people do whatever they

18 please, and they say, gee, you know, in our country? Come

19 on. We do this. And everybody else says, gee.

20 MR. SIU: Well, that was a state of the art

21 report, and that was I believe the intent of the state of

22 the art report to say what people are doing.

23 DR. APOSTOLAKIS: Yeah. That's what I'm saying.

24 The state of the art is very sad in this world.

25 MR. SIU: Well--

1 DR. POWERS: Well, if you've ever tried to put
2 together one of these state of art reports like that, you'll
3 quickly learn that anything beyond gee will only get you
4 storms of review comments.
5 DR. APOSTOLAKIS: Yeah, I know.
6 MR. SIU: And certainly, we're free to take the
7 results and insights from that report and apply them to as
8 we best see fit. You know, at -- I think the international
9 program that I referred to is going to be stronger than that
10 because there will be cross comparisons of code predictions.
11 It will eventually get to the point where people are
12 comparing against experimental data. And, again, hopefully
13 lead to a better understanding of when we can believe the
14 code results and when we can't.
15 DR. APOSTOLAKIS: Are any of these codes
16 calculating what you need to do a fire risk assessment,
17 namely the time to damage of something?
18 MR. SIU: Some of them -- well, all of them will
19 give you some input that you can use in that computation.
20 DR. APOSTOLAKIS: But they don't do it directly,
21 do they?
22 MR. SIU: I'm sorry.
23 DR. APOSTOLAKIS: They don't do it directly,
24 though. They don't get the time to--
25 MR. SIU: You can put in some of these codes, not

1 all of them, you can put in a thermal element that says
2 okay, this is the temperature of that element, and then
3 outside the code, say, by definition, damage time,
4 temperature is such and such. Yeah, you can monitor what's
5 going on.
6 Whether -- a lot of these codes have not been
7 designed with the needs of our style fire risk assessment in
8 mind, of course. And I would -- wouldn't be surprised if
9 some of these codes need to be modified if they are brought
10 into our arena to be used.
11 DR. APOSTOLAKIS: So why did the French develop
12 those codes? I mean, if they are not doing risk assessment,
13 why did they do it? Just to understand -- improve
14 qualitative and quantitative understanding of fire behavior?
15 MR. SIU: Well, I guess I shouldn't speak for the
16 French why the--
17 DR. APOSTOLAKIS: You should not speak for the
18 French. Okay.
19 DR. POWERS: Let me ask a question about the
20 computational fluid dynamics coding. I was wondering is
21 that getting, is that sufficiently sophisticated to speak to
22 this question of what's a prototypic fire for testing
23 purposes?
24 MR. SIU: I think you can -- you could use it in
25 that fashion actually, maybe pretty well. I haven't

1 honestly thought about that very much. I mean, you know how
2 these codes run. They basically -- at least with the NIST
3 code, you have to assume a certain initial condition of the
4 fire. Basically, they represent little packets of heat
5 release and send it off, and the flow induced by that heat
6 release, and get some very realistic looking pictures of
7 fire that qualitatively look pretty good. Quantitatively, I
8 guess they're still making sure that they -- they can match
9 up.
10 But empirically, one could adjust those things to
11 -- at least get quantitative benchmarking in some
12 situations. Now, can you turn that around and say, okay,
13 now, I'm going to develop a particular cable tray
14 configuration that reflects what I know from the CFD
15 application. Yeah, you -- that would probably make some
16 sense. We're not probably there yet to do that.
17 DR. POWERS: My experience with CFD codes is
18 enormously limited, but it says that especially in highly
19 turbulent and non-isotropic turbulent situations, they work
20 best when you have a good data set to compare against, at
21 least for some test configuration.
22 MR. SIU: Yeah.
23 DR. POWERS: Because of the difficulty in modeling
24 turbulence, and especially non-isotopic turbulence with
25 K-alpha. Our K-epsilon models just are inappropriate as all

1 get out.

2 MR. SIU: Well, you're way beyond me at this

3 point. I -- as an empiricist, I think that, again, one

4 could probably come up with ways to adjust the predictions

5 for the needs. Like you said, if you're just defining what

6 the test apparatus should look like, one could probably do

7 that reasonably successfully. Whether you use that in a

8 risk assessment. I mean, there are all sorts of issues

9 besides that. Just simply whether it's economically

10 feasible to do that. And so we don't know. We've got a

11 task -- actually, a carryover from the fiscal year '98 plan

12 that said, we're going to investigate the feasibility of

13 using these codes in the fire PRA realm. Maybe not

14 directly. Maybe benchmarking other codes. Something along

15 those lines.

16 Okay. Just again, I don't know -- well, we have

17 enough time. We can go through the sub-bullets here.

18 Again, we talked about the fire risk requantification study,

19 and I'll get to that in a couple of slides, but that's going

20 to address the first bullet, which is basically, we'd like

21 to see what happens to when we apply these improved methods

22 to a realistic situation. Obviously, from that application,

23 we would expect to get insights regarding the topics that we

24 brought forth at the very beginning of this program, the

25 infamous list of 42 if you will. We'll hopefully have

1 something to say about each and every one of those topics
2 once we get a chance to apply the methods, tools, and data.
3 DR. POWERS: Well, I know that some people were
4 critical of the 42 list. I thought it was a tremendous
5 achievement. But I get the impression that what you've
6 gotten from the kinds of things that Fred and the owners
7 groups have been talking about the kinds of things that
8 emerged from the insights on NPP fires is that list might
9 have grown some.
10 MR. SIU: Some. Yeah, I mean, the list was
11 actually -- had elements that were broad enough that
12 probably could cover some of the things that we're talking
13 about.
14 DR. POWERS: I mean, the trick is to get a list of
15 real focused, specific things.
16 MR. SIU: Yeah, right. In terms of our second
17 objective, one of the things that we are contemplating
18 broadening this research program to cover are the issues
19 that are being raised in non-reactor applications. We've
20 been -- issues associated with gaseous diffusion plants, for
21 example, have been brought to our attention, and see the
22 possibility for some results of our work for reactors -- and
23 we can see that spinning off into the analysis of GDPs. So
24 the wording on the second major bullet has been broadened
25 intentionally to cover the program office, and not just look

1 at reactors.

2 DR. POWERS: I would expect that this MOX facility

3 that people are talking about would make broad use of fire

4 risk assessment technologies.

5 MR. SIU: Okay. Obviously, we have a number of

6 activities supporting some of the activities that I

7 mentioned earlier. Of course, the risk informed performance

8 based rule. We would provide support to that. Support the

9 significance determination process. Improvements of that

10 process that's currently being used now.

11 The committee pointed out that we don't have

12 anything ongoing in analyzing the risk significance of fire

13 induced core damage precursors. That was something that we

14 had identified as one of our list of issues, but hadn't

15 allocated any effort towards that, so at least right now,

16 there's an element in the plan that would go after that. I

17 don't know that frankly it's going to be that difficult to

18 do, but that's something that we hadn't addressed up to this

19 point.

20 And then you see the last sub-bullet gets after

21 the materials applications.

22 On our third major bullet, we've added the notion

23 of evaluation as well as development because there are tools

24 that people are using now in support of decision making, and

25 the natural questions comes up, the same question that

1 arises when you talk about fire modeling. To what extent
2 can we use these tools, method and tools for a particular
3 problem.
4 So that would -- that general bullet now covers
5 these activities I've got listed below. We're going to
6 complete the development activities that you saw, that list
7 of 15 tasks that we started in fiscal year '98, and we're
8 going to finish that hopefully fairly soon this fiscal year.
9 And then, again, developing sites regarding the application
10 of these methods in practical studies. That's the
11 requantification effort. We do hope after we perform some
12 applications to develop guidance that would be useful into a
13 variety of users. And I've put down as the last bullet
14 here, support a variety of international activities,
15 including this one on benchmarking fire models and
16 developing improved fire models.
17 The tasks that we are contemplating are written at
18 a higher level than the original set of tasks. We had 15,
19 if you remember. Most of those 15, the ones that haven't
20 been completed, have been subsumed into the first task,
21 which is fire risk assessment tool development. Again, I'll
22 mention this requantification study on the next slide. Then
23 we have a variety of other activities.
24 Now this is going to cover fiscal years 2001 and
25 2002, so some of these things we wouldn't be starting on

1 right away, such as task four, the fire risk assessment
2 guidance development. That would happen, of course, after
3 we learned what we need to learn from the requantification
4 effort.
5 You'll see that tasks five through nine start
6 addressing things that were outside the direct thrust of our
7 initial efforts. I'm sorry, five, of course is rule making
8 support, but six we have a variety of issues that are risk
9 related but not necessarily focused on fire risk assessment,
10 and so we're going after some of these issues, and I guess I
11 just leave it at that for now.
12 I did want to mention the requantification study.
13 I see that as a important activity for us. So this was the
14 task two in the revised plan, of the draft revised plan.
15 And there are a number of things here. We want to develop
16 state of the art fire CDF estimates. And through the
17 application of our -- the methods, tools, and data that
18 we've been developing in the research program. And, of
19 course, we'll address uncertainty, the issue that was raised
20 this morning. That's a -- it's a serious question and
21 there's some -- I guess we hadn't thought about some of the
22 issues that might need to be addressed there.
23 Certainly, we want to talk about the difference
24 between the estimates that we develop using the improved
25 methods and those developed using older methods that will

1 get us a better handle on limitations or uncertainties
2 associated with the use of earlier tools, such as five, such
3 as other -- the older fire PRA methods that we've been using
4 largely unchanged since the beginning. I mentioned already
5 developing insights regarding the key fire risk assessment
6 topics. And really important to us, we want to develop
7 practical examples. We think that we have to test the
8 methods and tools in the field to see what we can really do
9 in the scope of a practical study, because we can't
10 continually say you've got to treat every possible issue
11 that arises. So it has to be done in a fashion that
12 somebody can actually do something with a finite budget.
13 And, of course, we will identify areas for further
14 improvement as part of this activity.
15 To do a decent study, we can't do it sitting in
16 our offices, of course. We have to cooperate extensively
17 with utilities, and so right now we need to identify
18 partners that will work with us on this, and these -- the
19 roles of these partners is really what's open to question
20 right now. We don't know -- I mean, obviously somebody who
21 joins in with us will have his or her own specific needs to
22 entice them to participate in this -- such a study. We'd
23 have to address those needs. And those needs can vary from
24 plant to plant, from utility to utility. So we see some
25 discussion is needed with the utilities to see how they --

1 how they would plan to participate. It could range all the
2 way from the utility performs a study and we kind of look
3 over their shoulder, until the opposite, we perform the
4 study, and they look over our shoulder. I would expect
5 reality would be somewhere in between. We've had some
6 highly preliminary contacts with a number of folks who said
7 they are interested at least in hearing a little bit more
8 about what we want to do. And we're going to be following
9 up on those contacts, hopefully in the near future.
10 I have this -- a second point here, interaction
11 with EPRI. I mentioned we have a memorandum of
12 understanding with EPRI right now in fire risk assessment.
13 EPRI's current plans, as I understand them, are to develop a
14 revised fire PRA guidance in year 2001. That would be about
15 the same time we'd be starting the requantification effort.
16 So to efficiently use available resources, it makes sense to
17 us to talk about coordinating these two activities, rather
18 than having them go on in parallel.
19 DR. APOSTOLAKIS: Are they going to revise the
20 fire PRA or five?
21 MR. SIU: Fire PRA.
22 DR. APOSTOLAKIS: What is it they are going to--
23 MR. SIU: The fire PRA implementation guide. That
24 was the -- you know, Bijan can speak to that.
25 MR. NAJAFI: I just want to make one

1 clarification. The plan at this point is to start revision
2 of the fire PRA methods, the EPRI's method in 2001. But
3 we're not sure. To complete it, it may be a multi-year
4 project, but it is working on the guide and incorporating it
5 in a number of issues that has come up through the IPEEEs
6 and other applications similar to 805, and -- but it's part
7 of a plan to do -- revise the guide, starting in 2001.
8 DR. APOSTOLAKIS: Can you send me a copy of the
9 guide as it is now?
10 MR. NAJAFI: I think they should have a copy.
11 Under that memorandum of understanding, NRC has a copy of
12 the guide.
13 DR. APOSTOLAKIS: Can I get a copy?
14 MR. NAJAFI: Sure. We'll get you a copy.
15 DR. APOSTOLAKIS: With a nice cover.
16 MR. SIU: For nice covers, maybe we should go back
17 to EPRI.
18 DR. APOSTOLAKIS: But I'm talking to him.
19 MR. SINGH: I'll get you a copy, Jim.
20 DR. APOSTOLAKIS: Okay. Thank you.
21 MR. SIU: This guide was used extensively in many
22 of the IPEEEs. Okay. So some concluding remarks. We have
23 been supporting a number of the ongoing regulatory
24 activities with our research results. In fact, again some
25 of the discussions we've had on circuit analysis this

1 morning, we've been supporting that discussion as well. We
2 are participating in cooperative efforts with industry and
3 international organizations, and we talked about those. We
4 recognize that the needs for research support are evolving
5 and so obviously we need to change the plan to meet those
6 evolving needs, and we're doing that. And I do believe,
7 again, that this requantification study will be a major
8 milestone. It will take a significant amount of effort from
9 us to do that.
10 DR. APOSTOLAKIS: Now, you said that you don't
11 plan to replace COMPBURN, and at the same time, somebody is
12 studying the model uncertainty. Is that going to be --
13 whatever code is being used, there will be a statement of
14 uncertainty about its predictions.
15 MR. SIU: Yeah, I would--
16 DR. APOSTOLAKIS: And that statement will be based
17 on some sort of observations or--
18 MR. SIU: Right. I would expect that.
19 DR. APOSTOLAKIS: That's a good idea, which is
20 what we're going to have to try to do with the
21 thermohydraulics codes. It will not be best estimate any
22 more.
23 This--
24 DR. POWERS: Now, why won't we have best estimate
25 thermal hydraulics?

1 DR. APOSTOLAKIS: Because it's a ridiculous name.
2 They should give you a code and a statement of the
3 uncertainties and its predictions, just as COMPBURN tended
4 to do 20 years ago, and now they're going to take it to the
5 next level, right? Since Dr. Wallace is not here.
6 DR. POWERS: Yeah, but I'll be glad to report back
7 to him to look at these.
8 MR. SIEBER: Well, there's a transcript. He
9 knows. He knows.
10 DR. APOSTOLAKIS: Which he will read immediately
11 right, upon release?
12 MR. SIEBER: Right. I have a question, which is
13 really -- your answers would be your opinion based on what
14 you know and what work you've done so far, but -- and both
15 Nathan and Steve if you could both respond, I'd appreciate
16 it, but in the -- Mr. Gorman's presentation this morning,
17 for the BWR Owner's Group Guidance, his slide number 34 has
18 a statement in it that says a hot short is an engineered
19 circuit failure. This fact suggests that a hot short has a
20 low probability of occurrence. It seems to me that, though,
21 when you were going down through the event history that
22 there were spurious actuations which come from hot shorts.
23 Do you agree with the BWR Owner's Group statement in that
24 regard?
25 MR. SIU: I'll take a crack and then I'll let you

1 crack.

2 MR. NOWLEN: Okay.

3 MR. SIU: Well, first of all, I think, and Tom
4 would probably agree that the slide probably should have
5 said something about spurious actuation because actually I
6 think the example really got not just the hot short, but the
7 subsequent spurious actuation of equipment. That being
8 said, I think the data indicate to me that under some
9 circumstances, just as Steve has pointed out, hot shorts
10 could be pretty likely or are pretty likely. Let's be more
11 definitive about that. I mean, it makes sense. You have
12 the -- especially if you're talking conductor to conduct
13 within a multi-conductor cable.

14 MR. SIEBER: True.

15 MR. SIU: And what would occur if not that.
16 Whether or not that leads to a spurious actuation is, of
17 course, the point of the NEI tests to show that there is
18 maybe some additional margin beyond that. I think the
19 review of events shows that clearly you can get spurious
20 actuations in real life fires without arguing necessarily
21 about how likely they are. We don't have many cable fires
22 in the database period. So you just can't say definitively,
23 you know, the probability is such and such just based on
24 that database. At this point, it seems to me under some
25 circumstances, spurious actuation is certainly plausible,

1 and the hot short is likely. Sandia's report has also
2 pointed out situations where a hot short is not likely under
3 some particular cable configurations, short to ground is the
4 most likely thing. So there isn't a single hot short
5 probability. And that was perhaps one of the things we --
6 we went into this study postulating that you need to
7 distinguish among these different situations and I think the
8 Sandia work shows that, yes, indeed, you need to
9 distinguish. You shouldn't just say a cable is a cable is a
10 cable.
11 MR. SIEBER: Yeah, okay.
12 MR. NOWLEN: Yeah, and I would just add that, you
13 know, again, we do see that distinction between hot short
14 and spurious actuation, and what we're really worried about
15 are the spurious actuations in the other circuit, behaviors
16 that might be risk important. I would echo what Nathan said
17 that, you know, each circuit needs to be analyzed on its own
18 merits, and certain types of circuits may be, and cable
19 configurations may be quite prone to spurious actuation
20 frankly and others may be quite unlikely. But it is a
21 combination of a number of factors that will make that
22 determination. The type of the cable. Its configuration.
23 The features of the circuit itself. So there is no one
24 answer. Some will be high. Some will be low, I think
25 ultimately.

1 MR. SIEBER: I have another question regarding the
2 research program. You've laid out your plan, which will run
3 through the next couple of years. The projects you're going
4 to start next year. I'm sure that in the process of putting
5 together your plan, you had to make some hard choices about
6 things that you would like to do, but decided that you
7 should leave off because you may not get the funding or
8 resources to do. Maybe you could tell me what a few of
9 those items might have been had resources not been so tight?
10 MR. SIU: One of the things -- well, first of all,
11 to soften that a little bit, you've seen the tasks
12 descriptions at a high level.
13 MR. SIEBER: Right.
14 MR. SIU: And we haven't gotten to the point in
15 the planning of saying at a very detailed level this is
16 exactly what we're going to do under REACH-1. So we know
17 we'll have an activity in an area. Now, how good of an
18 answer we want in each of these areas is kind of the
19 determining factor in saying how much resource we put in.
20 So, for example, with our follow-up on circuit failures. We
21 could certainly spend a lot more time and effort doing
22 experiments to -- if the circuit report had a table that was
23 -- I don't know three, four pages long -- identifying all
24 the factors that could and probably do affect the likelihood
25 of a particular failure mode. And certainly no test that is

1 being planned now. The test series that's being planned now
2 by NEI is not going to cover that. You know, if you had, if
3 you're going to a wish list, you could say, gee, I'd like to
4 have that covered much more extensively. If you broaden
5 that to say experiments in general, and getting this -- that
6 kind of information to support modeling efforts in a variety
7 of areas, obviously these are important to us. Fire
8 modeling is another place where clearly at some point, we'll
9 have to go beyond the simple exercising of computer codes
10 and say, compare them against data. We've got some data to
11 do that, but you can always come up with additional
12 scenarios that you'd really like to look at. So, you know,
13 again, if we're -- again, on the wish list path, we would
14 certainly look into the non-nuclear fire events I think in
15 more detail than we're able to run down now. We're doing
16 the best we can talking with folks who have a database on
17 such fires, but one can always track the information down
18 and get more that you can use in an assessment. So it's
19 data, data, data.
20 MR. SIEBER: You've talked about the circuit
21 failure experiments. Do you think just by data review you
22 could get more insight into the hot shorts and spurious
23 actuations issue?
24 MR. SIU: I guess I don't understand the question.
25 MR. SIEBER: Well, you reviewed 25 events and

1 didn't review them other than to identify the fact that
2 spurious actuations occurred in certain cable fires.
3 On the other hand, is there a lot more data that
4 you could use to establish the frequency probability, given
5 a fire, and perhaps even as specific as knowing what kind of
6 cable and what the configuration of the cable tray or
7 structure was?
8 Or is that just too hard to do?
9 MR. NOWLEN: Well, we did do a review of the
10 available experimental data, and considered some 50 reports
11 that are publicly out there on various cable failures.
12 And, again, that's the data that isn't really
13 ideal. It doesn't really address the question, or it wasn't
14 intended to address the question we're asking, so it has its
15 limitations.
16 MR. SIEBER: Right.
17 MR. NOWLEN: The events, I think, are that large
18 cable fires are relatively rare events, and we've probably
19 wrung out about as much as we can get today. If we have an
20 event tomorrow, I think it's certainly a question to ask in
21 the future.
22 The problem with going with historical events is
23 that, again, was there a focus on this question, and if
24 there was no specific focus on the question, you're not
25 likely to find much information.

1 It is not typical of a fire event report to
2 discuss how specific electrical equipment performed during
3 that fire. They are more focused on --
4 MR. SIEBER: Of if the cables worked.
5 MR. NOWLEN: How big was the fire? How long did
6 it take us to put out? What sort of suppression methods did
7 we use? Was anyone hurt?
8 You know, it's more the classic fire protection
9 perspective, so it's very difficult to wring that
10 information out of actual events.
11 MR. SIU: We ran into some of these difficulties,
12 actually, with the Brown's Ferry review, because what you
13 really have to do to go beyond the report is look at the
14 actual circuits involved.
15 MR. SIEBER: That's right.
16 MR. SIU: And depending on whether you've got
17 exactly the particular configuration that was there at the
18 time of the fire, is open to question.
19 Now, that's the case where we're able to get some
20 information. You run down a fire in Eastern Europe, and I
21 don't know how you're going to get it.
22 Again, you could maybe with the right agreements
23 and enough resources, you know, track it down, if the
24 information is actually available.
25 MR. SIEBER: You mentioned using NEEL as a data

1 source. Have you talked to ANI in Hartford or one of the
2 other them who usually has a fire protection person on the
3 site, and they cover a wider variety of events that pay off
4 more than NEEL does.
5 MR. SIU: The NEEL effort is a voluntary reporting
6 effort that, again, the criteria involved don't have to do
7 with the dollars lost. It's simply, was there a fire?
8 And you define the fire, and there was a flame, or
9 there was evidence of fire, and there are a few other
10 criteria that in principle should capture almost everything
11 that we're concerned about, except perhaps --
12 MR. SIEBER: Small fires.
13 MR. SIU: Extremely small, smoky events that maybe
14 didn't get to a fire yet.
15 MR. SIEBER: Okay. Are there any other questions
16 from the members? Yes, Mr. Gorman?
17 MR. GORMAN: This is Tom Gorman from the BWR
18 Group. I'd just like to clarify one point relative to --
19 our definition of hot short also includes a spurious
20 operation.
21 We take a look at the conductor, and we postulate
22 that another conductor with the correct potential, and at
23 the proper voltage, comes in contact with it and causes it
24 -- and that does cause a spurious operation.
25 So we don't make the same distinction that Sandia

1 and NRC Research are making relative to that phenomenon.
2 And the other consideration is that our point is not that
3 hot shorts and spurious operations don't occur.
4 In fact, we assume that we do get a hot short that
5 causes a spurious operation for each improperly located
6 cable. So we end up evaluating for many, many spurious
7 operations.
8 The point where we step aside is, we don't believe
9 it's necessary, based on the nature of that fault to
10 consider selected combinations of hot shorts causing
11 spurious operations.
12 MR. SIEBER: You mean which portions of the
13 circuit are actually causing the spurious operations?
14 MR. GORMAN: No, we don't believe it's necessary
15 to assume that we're going to get a hot short on this
16 particular component, and then a subsequent hot short on
17 another component, and the net effect of those two hots
18 shorts is an improper lineup for a system.
19 MR. SIEBER: There's a synergism involved?
20 MR. GORMAN: Yes, yes.
21 MR. SIEBER: Thank you.
22 MR. GORMAN: You're welcome.
23 MR. SIEBER: Any other questions?
24 [No response.]
25 MR. SIEBER: If not, we're exactly on schedule,

1 and I suggest we take a break until 3:45.

2 [Recess.]

3 MR. SIEBER: Will the meeting please come to

4 order? Our normal Designated Federal Official is not here,

5 so I'm having Mike Markley, a member of the ACRS staff, as

6 an engineer sit in until he returns.

7 Our next subject is the proposed NFPA 805 Fire

8 Protection Standard, and I'd like to introduce Fred Emerson

9 of NEI who will give the introduction, introduce the rest of

10 the speakers

11 MR. EMERSON: Thank you. The slide up there now

12 gives the names of the speakers in the order that we'll be

13 addressing NFPA 805 in. Now, all of the speakers, with the

14 exception of me, are either members of the Committee who

15 developed the standard, or had substantial roles -- and I do

16 mean substantial -- in preparing information for it, or

17 conducting pilots for it.

18 NEI has a representative on the committee, but he

19 could not attend this meeting. We'll begin -- I'll give a

20 few introductory comments.

21 Rich Bielen, from the NFPA, who is the liaison

22 with the NFPA for the Technical Committee on Nuclear

23 Facilities will speak on the summary of the committee status

24 and where they are with respect to the standard.

25 Cliff Sinopili, from PECO Energy, will give an

1 overview of the standard, and he will go through the whole
2 standard fairly quickly.
3 And then we'll take one of the chapters of
4 interest in the standard, Chapter 3, which provides the
5 fundamental elements, and describe that.
6 Dennis Henneke, from Southern Cal Edison -- and
7 we're working our way around in order here -- will talk
8 about the risk methods used in the standard.
9 Bijan Najafi will speak to the fire modeling, and
10 Dennis -- I'll speak a little bit about the circuit analysis
11 provision.
12 Dennis Shumaker, at PSEG, who's at the Salem
13 Plant, conducted the pilot evaluation. We'll talk about the
14 results of that and I'll summarize.
15 With all these speakers, and two hours to do it
16 in, we're going to try to be fairly expeditious in getting
17 through this, so the purpose of this talk is to summarize
18 the status of the standard, and to provide the perspective
19 of industry members who were involved in its development,
20 its organization, development and intended use, strengths
21 and weaknesses, and the pilot application.
22 The Commissioner direction for the staff in
23 developing the standard, the staff was directed to work
24 closely with NFPA and to help ensure that the proper
25 risk-informed performance-based approach is maintained.

1 Both industry and staff have provided extensive
2 support for the committee in developing this standard.
3 Industry sees potential benefits for completing
4 the standard. The initial purpose of the standard was to
5 develop an alternate licensing basis, an optional licensing
6 basis that utilities could use.
7 This was the Commission's direction on how to
8 risk-inform the existing regulations in fire protection.
9 After discussions between staff and industry,
10 there was also the use of risk-informed change methods to
11 support exemptions and deviations within the current
12 licensing basis, which is an optional use of the standard as
13 well.
14 The industry supports completing and implementing
15 this in a timely way, however, there are some issues that we
16 have with the standard that we would like to see addressed
17 and we'll be getting to those as we go through the
18 individual presentations.
19 I'll briefly describe an overview from NEI's
20 standpoint of the principal issues that we have with it.
21 Chapter 3, which Cliff will discuss later,
22 explains the fundamental elements of the standard, the
23 fundamental elements being something that any fire
24 protection program would have to address under the standard,
25 with performance and risk options for doing other things in

1 other parts of the standard.

2 We agree with the concept of fundamental elements,

3 but we don't feel like there's enough flexibility in how you

4 do that; that it's not sufficiently performance-based.

5 It does apply prescriptive approaches and

6 performance-based approaches are not permitted, and I'm sure

7 you'll hear from the staff tomorrow about their view of

8 that.

9 The prescriptive approach also adds requirements

10 that are not addressed in current licensing bases.

11 The other principal issue we have is with the

12 Appendix B circuit analysis, and I should add that the

13 Appendix B is not a requirement by the rules of the NFPA,

14 but it does provide guidance which we feel is beyond current

15 requirements, and I'll be talking about that more later.

16 DR. POWERS: Well, let me ask this: You can

17 collect all these experts on fire together, and they think

18 about these issues and they come up with things that out of

19 their expertise, they say, gee, this ought to be a

20 requirement.

21 And it's different or in addition to what's in the

22 current licensing bases. I mean, shouldn't you give pretty

23 strong hearing to these guys?

24 I mean, they have been in this business for a long

25 time, and, I mean, they know what they're talking about.

1 There's no reason to think that the current
2 requirements really constitute a complete set of things that
3 should be required.
4 MR. EMERSON: True.
5 MR. SINOPILI: I think I'll address that in
6 Chapter 3, because a lot of that comes home to rest in
7 Chapter 3, and we talk a little bit about how that happened,
8 and where some of those requirements, quote, new
9 requirements came from. Hopefully I'll answer that in the
10 Chapter 3 part.
11 But the bottom line is this: A lot of the new
12 requirements are actually requirements that are already
13 existing requirements, but for a lot of plants, it's
14 subsequent to what they were licensed to.
15 DR. POWERS: But suppose in the abstract case, all
16 these experts, the whole panel of experts and the wide
17 variety of backgrounds, with more modern knowledge than was
18 available at the time Appendix R and its antecedents were
19 formulated -- it wouldn't surprise me a bit if they came up
20 with a requirement that probably really ought to be imposed,
21 but nobody had thought about it at the time?
22 MR. EMERSON: I'll describe a little bit later,
23 what the specific issue we have with that is, and I'll try
24 to answer your question.
25 DR. POWERS: Sure. I mean, we have a -- one could

1 imagine that NRC could come back and say, okay, we didn't
2 have that, and we can't -- we're not going to try to impose
3 it because it won't satisfy the backfit rule.
4 But you could have those things. It just seems to
5 me that it's entirely possible. A lot of these things are
6 seeing the light of a broader audience than maybe they'd
7 seen in the past.
8 MR. EMERSON: I will answer your question.
9 MR. SIEBER: Good.
10 MR. EMERSON: With that, I'll introduce Rich
11 Ballooned.
12 DR. APOSTOLAKIS: The list of speakers, I mean,
13 there were other people that were members of the committee,
14 right?
15 MR. EMERSON: Oh, yes.
16 DR. APOSTOLAKIS: And the NRC staff was
17 represented on the committee?
18 MR. EMERSON: Yes. First Pat Madden and then Ed
19 Connell represented the NRC staff, and they participated to
20 a large extent. And Nathan Siu was also a heavy duty
21 participant in there, in their work.
22 MR. SINOPILI: We were also fortunate with, I
23 think, the exception of one meeting, at least for some point
24 in time during each meeting we had someone from NRR
25 supervision there as well. I think there was only one

1 exception, so we really -- NCR supplied a relatively high
2 level of support.
3 MR. BIELEN: Okay, my name is Rich Ballooned with
4 the NFPA staff. And I'm going to give you a very quick
5 overview of where we are in what we call the cycle for
6 generating new documents, and kind of where we go next from
7 here.
8 The items I'm going to cover are the committee
9 cycle, the present status of where we are. I'll talk a
10 little bit again about the committee process, and I briefed
11 the Subcommittee previously on what the committee process
12 is, but I might just go over that real briefly again to
13 refresh your memory, and then finish up with the
14 conclusions.
15 Okay, when we talk about committee cycle in the
16 NFPA process, it's the two-year process that we're talking
17 about to -- at least two years, two to three year-cycle,
18 probably, to generate a new document.
19 Initially, we were in what we call the May 2000
20 cycle, but due to the large number of proposals we had, the
21 committee revised their schedule to go into the November 200
22 cycle or the Fall 2000 cycle.
23 I'm going to cover some of the milestones that are
24 in that cycle in the next overhead. The Fall 2000 cycle, we
25 pretty much have done everything on this particular overhead

1 so far.

2 We've had the proposal closing date, we've had the
3 ROP meeting, the comment closing date. We had two ROC
4 meetings, which are reports on comments in San Francisco and
5 Philadelphia, to act on the comments.

6 And the report on comments has been mailed out to
7 the public at the end of September here. So that this page
8 pretty much is complete.

9 We haven't done this yet. This is where we're
10 heading. Next month in Orlando, the NFPA membership gets to
11 vote on NFPA 805.

12 If it passes the floor vote by the membership, it
13 then goes to the NFPA Standard Council for issuance in
14 January of next year. And then in around March or April,
15 the document actually is out and on the street, so people
16 will be able to get a copy of NFPA 805 around the
17 March/April timeframe.

18 Present status of NFPA 805: Right now, we're in
19 the waiting mode. We're waiting for the November vote by
20 the NFPA membership in Orlando.

21 There are no more committee meetings by the
22 committee; there will be no more changes done by the
23 committee at this time, so we're pretty much at the end of
24 the cycle as we know it.

25 DR. APOSTOLAKIS: Does this mean that the staff

1 has accepted this?

2 MR. BIELEN: I'm sorry, does this mean that the

3 standard is accepted?

4 DR. APOSTOLAKIS: The NRC staff.

5 MR. SIEBER: No.

6 DR. APOSTOLAKIS: So the staff will evaluate it

7 afterwards?

8 MR. SINGH: Staff has to look at it and then go

9 through the process of whether they are going to endorse it

10 or not. But staff is a member of the committee, one of the

11 members.

12 DR. APOSTOLAKIS: That's what confuses me.

13 DR. POWERS: They ordinarily wouldn't endorse a

14 standard until after it was published.

15 MR. BIELEN: Right, we're not there yet. We still

16 have a couple of these steps here with the November vote,

17 and then the issuance of the document by the NFPA Standards

18 Council.

19 So I would imagine that after that, at that point,

20 maybe after it gets published, the NRC staff would be

21 evaluating it.

22 The only changes that can be made right now are

23 from what we call the floor of the Association meeting in

24 November, where someone could get up -- actually, they could

25 vote to accept the standard, as is.

1 If there are some amendments, we could have floor
2 amendments, so we could have some changes by floor
3 amendments. We could have a portion of the report returned
4 to the committee, if someone wishes to do that.
5 Or they can return the entire report back to the
6 committee for further work, if we need to do that. So those
7 are some of the steps that can happen, where we need to go
8 next.
9 DR. APOSTOLAKIS: So, Fred, this is where you're
10 going to have a chance to ask them to do certain things?
11 MR. EMERSON: That option exists, yes, and that
12 would be the appropriate time to do it, is on the floor, to
13 make amendments or return things back to the committee.
14 MR. BIELEN: Right now, there is no other step in
15 the process. The committee isn't going to meet anymore.
16 The committee process, just to refresh your
17 memory, it starts off with the balanced committee where we
18 have no more than one third of any particular interest group
19 on the committee.
20 They then drafted a copy of NFPA 805, which was
21 released to the public. The public had a chance to submit
22 proposals on that draft, and the committee acted on those
23 proposals in what we call the ROP period.
24 Then there's a comment period, and the committee
25 acted on the comments at the ROC period. We have to have a

1 consensus agreement from the committee, which means that
2 two-thirds of the committee has to be in agreement before
3 the document can move forward.
4 And we're at that point where we have two-thirds
5 agreement at the ROP and the ROC stages. NFPA membership
6 then gets a chance to vote the document, as I mentioned, in
7 Orlando.
8 And the NFPA Standards Council issues the document
9 in January.
10 To wrap up my comments, NFPA 805, as I said
11 before, is at the end of its cycle, so we're very close to
12 completion. There will be no more changes, except floor
13 amendments.
14 The document, once it's in cycle, will be revised
15 every three to five years. That's the way the NFPA process
16 works, a minimum of three years and a maximum of five years.
17 So between three to five years, all our NFPA
18 documents get revised.
19 It was developed by a balanced technical
20 committee, and it is a consensus document.
21 So do we have any questions on where we are in the
22 NFPA process or the cycle?
23 [No response.]
24 MR. SINOPILI: Thanks. I'll take over from here
25 with an overview.

1 My name is Cliff Sinopoli and I'm a --

2 COURT REPORTER: Microphone, please.

3 MR. SINOPILI: I'm a Fire Protection Engineer at

4 Peach Bottom, and I've been a member of this technical

5 committee for a number of years now, and I've been asked to

6 provide just a quick overview of the standard itself, and

7 then we'll have different speakers, as Fred said, that can

8 give a little bit more detailed overview.

9 I'd like to talk about a little bit, first,

10 though, is what's the evolution of this document? How did

11 it come to be?

12 The NFPA committee process, from a little bit

13 different aspect than what Rich just described. Then again,

14 I'll go into the document itself.

15 The roots, as it were, of NFPA 805, can really be

16 traced back to SECY 92-263, which was the plans for

17 elimination of requirements of marginal safety. This

18 identified that some fire protection requirements were

19 potentially over-prescriptive.

20 This, in turn, led to SECY 94-090, which developed

21 some criteria for revising fire protection regulations. And

22 a couple of the highlights of those criteria: For example,

23 it said that we should establish safety criteria, but not

24 prescriptive methods of implementing those criteria.

25 And also they said that we should start

1 considering risk as part of any new regulation.

2 SECY 96-134 was options for pursuing regulatory

3 improvements of fire protection, and actually provided the

4 Commission -- the staff provided the Commission with

5 basically two options:

6 The first was to leave the regulatory framework as

7 is, and the second option was to either remove or modify

8 Appendix R, and make it more risk-informed. And the option

9 that the staff recommended was either removing or modifying

10 Appendix R, and at that time, the Commission concurred with

11 the staff's recommendation.

12 Based on that, the staff moved ahead with SECY

13 97-127, and provided an action plan for how to go about

14 either removing or modifying Appendix R with a more

15 risk-informed approach.

16 Slightly following that, Chairman Jackson received

17 a letter from NFPA, informing her of the proposed NFPA 805.

18 And in that letter it referenced OMB Circular A119, which

19 basically says if there is an industry consensus standard

20 that's either being developed or developed, that the Federal

21 Government will be encouraged to use that, if possible.

22 I think Fred mentioned SECY 89-058, that talked

23 about what really led to the development of NFPA 805 in

24 terms of being approved by the staff as a method to follow.

25 In fact, there were three options that were

1 presented to the Commission: The first option was that the
2 staff alone would develop a new risk-informed or
3 performance-based regulation.
4 The second option was to refer that development to
5 NFPA with 805, and then have an option to maintain the
6 existing framework of regulation.
7 And, finally, a third option was to leave
8 everything as it was. And the staff recommended Option 2,
9 and that's what the Commission selected. And, again, NEI
10 concurred with that and supported that recommendation as
11 well.
12 As Rich said, our original goal for NFPA 805 was
13 to have it ready for a vote at the May or the annual 2000
14 meeting. We created a draft for initial public comment, but
15 I believe that in February of 1999, Rich and some others
16 provided some information to ACRS about that initial public
17 draft.
18 We received a number of comments, and, in fact,
19 the number of 400 sticks in my mind, but there were quite a
20 few comments that we got form the public, and then we had
21 another round of comments which we received, again, in
22 excess of 100 comments.
23 Right now, we're on schedule to vote for NFPA 805
24 at the November 2000 meeting in Orlando in several weeks.
25 When we first started out, in fact, for years,

1 this committee has been primarily composed of traditional
2 fire protection types. I mean, when we have it, it's like a
3 Maryland reunion there.
4 There are people who have been on the committee
5 for a long time, but primarily with a pure fire protection,
6 traditional fire protection background.
7 And it became clear really quickly that we were
8 not going to be able to write a standard that was going to
9 meet anyone's expectations with that limited group of
10 people.
11 So at that point, we tried to get additional
12 assistance from PSA and Safe Shutdown folks. For example,
13 Nathan began to attend, Dennis began to attend, Jim Wepner.
14 We had several people that we got from outside, to try to
15 broaden, just this pure fire protection base.
16 And I think that was really positive though.
17 Throughout this process, we did have active industry and NRC
18 staff participation, as well as insurance companies were
19 represented, there were consultants represented.
20 We had manufacturers of equipment represented, so
21 it is a balanced committee, as Rich had said.
22 One of the things we ran into right up front was
23 that there wasn't a lot of existing risk-informed standards
24 that we could borrow from, and why this is important: I
25 happened to be on another standard at the time which was

1 being developed. And that was the alternatives to Halon.
2 So Halon was being phased out, and we had to write
3 a standard for new gases. Well, it was a lot easier on that
4 committee than it was on this one, because we basically took
5 the old Halon standard, a lot of the design criteria, and
6 just substituted the new information.
7 We didn't have that luxury of boilerplate
8 preexisting for 805. And we found that that made this much
9 more of a challenge.
10 In a lot of cases, as a committee, we probably
11 defaulted to the existing deterministic approaches because
12 that's what we were comfortable with. And it's tough to
13 break out of that box that we've been in for so long.
14 As we found, it was a learning process. It seems
15 like every time we got together, we revised the standard to
16 a large extent, but each time I would say that there was --
17 the committee was pretty comfortable that we were heading in
18 the right direction and we were making progress.
19 Right now, the way the document is set up, we have
20 six chapters and six appendices. And one thing that's
21 important to understand, per the NPFA Manual of Style,
22 things that are what we call in the body of the text, in the
23 chapters, are enforceable. The information in the appendix
24 is not enforceable; it's for information only.
25 And another important distinction that the

1 committee decided from the onset is that this would only
2 apply to existing light water reactors. In fact, we had a
3 comment, well, why can't this apply to heavy water reactors
4 like from Canada?
5 And the committee was very clear that that was
6 their intent; that this was only to apply to existing light
7 water reactors, because that's the information that we were
8 using to develop the standard.
9 One thing I wanted to talk about just real
10 briefly: As Rich mentioned, we typically have a three- to
11 five-year revision cycle for an NFPA standard. That's not
12 just 805; all the NFPA standards are that way.
13 And while there are some methods of doing
14 interpretations and making amendments to an existing
15 standard, they are relatively lengthy. But there is an
16 equivalency statement in NFPA 805, and, I believe, most NFPA
17 standards have a standard like this.
18 It says it's not intended to prevent the use of
19 new technology, something superior, something equivalent.
20 To fulfill the requirements of the standard with a
21 proviso that it typically is going to be up to the authority
22 having jurisdiction to determine if that is going to be
23 acceptable. And for the most part, that authority having
24 jurisdiction for 805 with be the NRC. So if things get
25 better, if we have new tools that are developed in the

1 future, this equivalency clause will allow us to do that
2 without actually having to rewrite the whole standard. So I
3 wanted to make sure that that was clear.
4 Chapter 1, in addition to providing a scope, it
5 discusses defense-in-depth. There was a discussion this
6 morning about defense-in-depth, and the defense-in-depth
7 that we reference in NFPA-805 is very similar to the
8 traditional Appendix R, NUREG-0800 type defense-in-depth,
9 prevention and suppression, detection, and then finally
10 barriers and shutdown would be the third level.
11 But we basically, in Chapter 1, establish goals,
12 objectives and criteria for the following areas, nuclear
13 safety, radioactive release, life safety. And I made an
14 error on here, we voted to -- even though there was a
15 majority vote to reject this, it is still in -- I don't know
16 how to say that right, but it is a little confusing when we
17 had the last vote. The Plant Damage and Business
18 Interruption will remain in the document, I mistakenly
19 thought we were going to delete it. And I will get to that
20 a little bit more later on.
21 But the key to this chapter, though, is we set up
22 goals, objectives and criteria that follow through the
23 various remaining chapters and the appendix of the document.
24 In Chapter 2, we establish the general approach to
25 be taken for using this document, for using this standard.

1 In a second I will put up a slide that is a little bit busy,
2 but you have one there. And it tells you how to use the
3 goals, objectives and criteria established in Chapter 1 to
4 determine what your fire protection requirements will be, it
5 provides for either performance-based or a deterministic
6 option.
7 And there is several packets you have, there
8 should be a packet that has three pages on it. And this is
9 the basic flow chart of the standard. Now, again, this has
10 been changed slightly, and I don't have the current changes.
11 There were some slight changes. But, in general, this is
12 the approach that we would take. And, basically, that
13 approach is to establish your fundamental program, which is
14 required by Chapter 3, and then using your performance
15 goals, objectives and criteria for the various areas,
16 nuclear safety, all life safety, radioactive release, to go
17 through an analysis, and you can use a deterministic
18 approach or performance-based approach.
19 And one key area, to draw back to something that
20 was discussed this morning, right here, what happens if you
21 make a change to a small part of your plant, do you have to
22 go back and look at the impact on your entire plant? That
23 is really what this does, this step right here. You need to
24 make sure that if you have a change to a small part of the
25 plant, what is its impact over all.

1 DR. APOSTOLAKIS: But if you have done, though, if
2 you have satisfied the standard using the deterministic
3 approach, would you have sufficient information to do the
4 risk-informed change evaluation?
5 MR. SINOPILI: That has been the subject of a lot
6 of conversation at meetings. So the understanding of the
7 committee is yes, you would. But there will be people who
8 would argue that you don't.
9 DR. APOSTOLAKIS: Well, it seems to me that you
10 would have to do a fire risk assessment, wouldn't you?
11 MR. SINOPILI: I would say, I would agree with
12 you, I think it presupposes that you have an existing
13 analysis, a risk analysis for your facility.
14 DR. APOSTOLAKIS: Now, let's look at the
15 performance criteria that are listed in Chapter 1. As I
16 remember, you were talking about K effective being less than
17 .99 or something like that.
18 MR. SINOPILI: I believe so.
19 DR. APOSTOLAKIS: And some temperature of the
20 coolant being less than a number. If I go -- if I follow
21 the right branch, righthand side branch, performance-based
22 approach, then, under performance basis, I am allowed to
23 look at risk, right?
24 MR. SINOPILI: That's correct.
25 DR. APOSTOLAKIS: Actually, I am required. Am I

1 required or I am allowed? I am required?

2 MR. SINOPILI: I believe you are required.

3 DR. APOSTOLAKIS: Required. Now, if I do that,

4 most likely I will come up with a result that will say, yes,

5 K effective will be less than .99, with probability 10 to

6 the -- I mean 1 minus 10 to the minus 6th -- 7th, whatever,

7 because it is a probabilistic approach. You can never be

8 able to say it will always be less than that.

9 And the standard, as I recall, is silent as to

10 what probability one should accept there.

11 MR. HENNEKE: No. No, it is not.

12 DR. APOSTOLAKIS: It is not silent?

13 MR. HENNEKE: This is Dennis Henneke, by the way.

14 It mentions in Section 2 that any change to the plant for an

15 individual feature, including all scenarios of analysis,

16 would be against a set criteria, and that the utility or the

17 plant should set that criteria and have that approved

18 through the AHJ. And in the appendix we basically refer to

19 1.174 as whether we thought --

20 DR. APOSTOLAKIS: But that brings up again the

21 issue we discussed this morning, you are talking about

22 changes. I am not talking about changes. I am talking

23 about the plant as is. I do a risk assessment, and then I

24 say, well, gee, you know, I tell my risk assessor, look,

25 what the standard wants is K effective to be less than .99

1 and the temperature of the coolant to be less than this.
2 And the guy comes back after he spent some money and says,
3 well, yeah, it is less than .99, with probability, you know,
4 .99999.
5 And then I go back to my performance criteria and
6 I don't find any probability. It says make sure it is less.
7 Isn't that a problem?
8 MR. HENNEKE: In this case, if you did fully
9 deterministic, which you wouldn't want to do because you
10 would just be in Appendix R space, but if you did fully
11 deterministic, you wouldn't be required by the standard, as
12 I read it, to do any PRA analysis.
13 DR. APOSTOLAKIS: I understand that, and I am
14 coming to that.
15 MR. HENNEKE: So if you go to the
16 performance-based route, then it is a change. It is a
17 change from deterministic.
18 DR. APOSTOLAKIS: Why is it a change? I am not
19 changing the plant.
20 MR. HENNEKE: Because right now we are fully in
21 deterministic space, and we are going to now change the
22 justification for the plant to a performance-based approach.
23 DR. APOSTOLAKIS: But Regulatory Guide 1.174
24 refers to changes in the licensing basis. So the licensing
25 basis here means what, that I am changing the rules of the

1 game? I am not doing anything to the plant.

2 MR. HENNEKE: No, you are changing your fire

3 hazards analysis from a deterministic support to now a

4 performance-based support. And if we already have -- if we

5 already in our licensing basis have performance-based

6 support through 86-10 evaluations or previous fire analysis,

7 that is already -- we don't have to do a PRA analysis on

8 that. But if we do anything new once the standard is

9 adopted, and we haven't done it in the past, that would be

10 considered a change.

11 DR. APOSTOLAKIS: But, Dennis, I am not

12 calculating delta CDF here. All I am doing is defining fire

13 scenarios and doing a baseline fire risk assessment. So

14 what is my delta DCF? There is no delta DCF, so I can't

15 go --

16 MR. HENNEKE: The delta is if you follow the

17 deterministic route versus if you follow the

18 performance-based. So, for example, you say I have a

19 three-hour barrier required for this wall. I don't want to

20 have a three-hour barrier, I want to have a two-hour

21 barrier, then there is a delta CDF --

22 DR. APOSTOLAKIS: I understand that, but that is

23 not what I am talking about. I am saying I am coming down,

24 I am not doing anything to the plant. I am not changing

25 doors, I am not doing anything. I am coming down to the

1 box. I have my performance criteria. I have identified the
2 SSCs. Then I decide to go to the righthand side,
3 performance-based approach. That requires a fire risk
4 assessment. This, in my mind, is a baseline fire risk
5 assessment, because I haven't changed anything. All it says
6 is look at your plant, and for each fire area, evaluate the
7 risk and so on.
8 So now I don't have a delta CDF, all I have is a
9 CDF, the contribution to CDF from fires, and that is a
10 standard PRA.
11 Now, first of all, I will have a problem
12 converting that to the criterion of K effective, but let's
13 say I can do that. Then I will still have a probability
14 that K effective will be less than .99, which will be very
15 large. But still the standard doesn't tell me what is an
16 acceptable probability.
17 MR. NAJAFI: The question you are asking is
18 related to how the standard is going to be implemented or
19 used by somebody.
20 DR. APOSTOLAKIS: Right.
21 MR. NAJAFI: It is two possible options that the
22 committee has thought of. One is if somebody is going to
23 use the standard and its methods as a tool to implement a
24 change. In that case, then you have a delta risk.
25 But you are talking about the case that this

1 becomes a licensing basis for the very first time for a
2 plant. Then in that case you are not calculating, you are
3 basically rebaselining. You are not calculating a delta
4 CDF. In the case that that becomes the licensing basis of a
5 plant, then you do have probably to need to have a fire risk
6 assessment to begin with, because you are establishing the
7 base, the new licensing basis.
8 DR. APOSTOLAKIS: The purpose of this standard is
9 not to evaluate changes, right? It is not.
10 MR. HENNEKE: It is to establish a process.
11 DR. APOSTOLAKIS: For what?
12 MR. NAJAFI: Fred, you might want to answer it.
13 MR. HENNEKE: For maintaining a fire hazard
14 analysis.
15 DR. APOSTOLAKIS: Okay. Maintaining a fire hazard
16 analysis. So, the NRC comes to me and they do the
17 inspections. They come up with a long list of things that
18 need to be fixed, and that is going to cost me $60 million.
19 Then this standard comes out, and I go and follow the
20 righthand side route, and I see that I meet the K effective
21 less than .99. I meet the temperature requirements with a
22 probability that is extremely high, five nines.
23 I am not changing anything. All I am saying is I
24 meet the standard and, you know, the federal government is
25 supposed to do that. I am producing probabilities, but my

1 performance criteria don't include probabilities. I am in
2 trouble, because then I have to convince the NRC staff that
3 the probabilities that I have make sense.
4 And then, let's complete the argument now. If I,
5 on the other hand, choose to go the lefthand side route,
6 there is an implicit assumption there that if I meet the
7 deterministic requirements, then I meet the performance
8 criteria, right? Because I don't know how I can do an
9 engineering analysis that will connect the separation
10 criteria between redundant divisions to K effective.
11 I have to say at some point, and I believe that if
12 I meet these requirements, K effective will be less than
13 .99. So if I go the lefthand side, I have to believe. If I
14 go the righthand side, I don't have enough guidance. Now,
15 what do I do?
16 DR. POWERS: You have to believe or have to
17 persuade, one or the other, George.
18 [Laughter.]
19 DR. APOSTOLAKIS: Am I misreading the standard or
20 is that a real issue?
21 MR. HENNEKE: I think you are misreading the
22 standard in some parts of it. I mean we in PRA have taken K
23 effective -- or the plant has shutdown into the PRA event
24 trees, that the reactor has tripped or boration has occurred
25 on an AWTS.

1 DR. APOSTOLAKIS: So the acceptance criteria then
2 will take care of that you are saying, in the event trees?
3 MR. HENNEKE: Yes.
4 DR. APOSTOLAKIS: But your acceptance criteria
5 here don't give me a probability, that is my problem.
6 MR. HENNEKE: You only get into probabilities if
7 you performance-based.
8 DR. APOSTOLAKIS: Yeah.
9 MR. HENNEKE: And then we say that, you have to
10 meet your PRA which has K effective and boration, and steam
11 generator cooling or whatever you have, and it has to be
12 less than a probability of 10 to the minus 6th per fire
13 protection feature.
14 DR. APOSTOLAKIS: And where did that come from?
15 MR. NAJAFI: That is as you said, that when it
16 gets to that probability, the standard leaves it to
17 something to be decided between the licensee and the AHJ.
18 It does not prescribe, right in the performance criteria
19 that says you meet the .99 at 10 to the minus 6. It does
20 not.
21 DR. APOSTOLAKIS: Does it say explicitly somewhere
22 that the AHJ and the --
23 MR. NAJAFI: The acceptance criteria for risk,
24 yes, there is somewhere that it says the acceptance criteria
25 for that, it defers it, which it was intentional to defer it

1 to that point.

2 MR. HENNEKE: Yes, Section 2.3.

3 DR. APOSTOLAKIS: So then if I choose to go the

4 performance-based approach, I will actually have to do more

5 work than is in the standard?

6 MR. NAJAFI: Oh, yes.

7 DR. APOSTOLAKIS: I will have to negotiate with

8 the NRC.

9 MR. NAJAFI: Yes, because at some point the intent

10 was that the performance criteria that you define, it has to

11 be flexible enough, because you are running the risk of

12 prescribing or pre-defining these performance criteria to a

13 level that it has too much details in it. That is the

14 balance that you have to maintain. I mean you can say, even

15 instead of .99 and keep going on and eventually say you got

16 to have -- eventually, you turn into your prescriptive

17 method, that to do that, then you have got to have fire

18 protection system and everything.

19 DR. APOSTOLAKIS: Yes. I mean I realize the last

20 several years being prescriptive has meant, you know,

21 something bad, but at the same time avoiding being

22 prescriptive and producing something that is not workable is

23 not a good idea either. So why would I go with a

24 deterministic approach? And why, if I were an NRC staffer,

25 should I accept that if I meet the Appendix R requirements,

1 K effective is less than .99? Because I wrote Appendix R?
2 Is there any other technical basis? I don't know of any.
3 It is a matter of faith.
4 MR. NAJAFI: If the question is that why even that
5 .99 was put in as a performance criteria --
6 DR. APOSTOLAKIS: No. How do I know that if I
7 implement the deterministic approach, which means Appendix
8 R, I comply completely? How do I know that your performance
9 criteria in the third box from the top have actually been
10 met? Is there any technical basis to convince me that I
11 have met those criteria, or is it a matter of faith?
12 MR. NAJAFI: Oh. Oh, you are saying that how do
13 you know that the left side is equivalent to the right side?
14 DR. APOSTOLAKIS: Is equivalent to the top, I know
15 it is not equivalent to the right. That the left -- in
16 other words, your arrows point down.
17 MR. NAJAFI: Yes.
18 DR. APOSTOLAKIS: Now I have reached the
19 engineering equivalency evaluations. Do I have any
20 confidence that my arrow now can go up and say, yes, I have
21 met the performance criteria?
22 MR. NAJAFI: Correct me if I am wrong, but I
23 believe the only technical basis I can think of between the
24 left side and what is the performance on the top is Appendix
25 R. I mean that is the link, the technical basis that links

1 the left side to the --

2 MR. HENNEKE: Well, no, and Appendix R has used

3 systems that are in the FSAR that are used, or credited in

4 the FSAR for shutdown of the reactor. So, the analysis for

5 the FSAR is, you know, --

6 DR. APOSTOLAKIS: So that is the only thing?

7 MR. HENNEKE: Yeah, I mean Appendix R had to be

8 based on, you know, systems that are already credited.

9 DR. APOSTOLAKIS: So I have to go back to the

10 justification for Appendix R, because it is the same here.

11 MR. NAJAFI: Yes. I mean on the left side.

12 DR. APOSTOLAKIS: On the left.

13 MR. NAJAFI: Yes.

14 DR. APOSTOLAKIS: And then there may be an

15 inconsistency between left and right?

16 MR. NAJAFI: The consistency between left and

17 right is that equivalency, engineering equivalency that it

18 is supposed to demonstrate that you meet the performance

19 criteria instead of whichever way you are fire modeling, a

20 risk showed you a three-hour is equivalent, or an

21 hour-and-a-half of suppression is equivalent to whatever the

22 righthand side is. That is the box in between.

23 MR. HENNEKE: George, you might wait till we get

24 to the discussion on that righthand side to kind of finish

25 your question there. I know where you are going. There is

1 a number of additional requirements that are required for
2 going down the righthand side, and the methods are a little
3 more complex.
4 MR. NAJAFI: In fact, I think even in the pilot we
5 will come back to that, because we also somewhat struggled
6 as a user, when do you go on the left side and when do you
7 go on the right side? I mean what is the situations you do
8 want to go left or right? So it will come back --
9 DR. APOSTOLAKIS: Right now, if I were a licensee,
10 I would go left.
11 MR. NAJAFI: It depends.
12 DR. APOSTOLAKIS: Because if you are asking me to
13 negotiate with the NRC staff, again, and you know how
14 difficult they are, --
15 [Laughter.]
16 MR. NAJAFI: Well, actually, we will point out --
17 DR. APOSTOLAKIS: You have to go to meetings.
18 MR. NAJAFI: We will point out the conditions that
19 somebody that they will only go to the right and never to
20 the left.
21 DR. APOSTOLAKIS: I'm sorry, there were some?
22 MR. NAJAFI: We probably will discuss those
23 situations that actually the inclination on the part of the
24 licensee was more to go to the right than to the left.
25 DR. APOSTOLAKIS: And the reason is?

1 MR. NAJAFI: I'm sorry?

2 DR. APOSTOLAKIS: And the reason is?

3 MR. NAJAFI: Well, we will talk about it.

4 DR. APOSTOLAKIS: I mean there is an inclination

5 that is caused by what? By not meeting Appendix R?

6 MR. SHUMAKER: That's correct.

7 DR. APOSTOLAKIS: That's correct. There is an

8 honest man. You are not meeting Appendix R, but you still

9 believe the risks are acceptably low. Let's complete the

10 sentence, right.

11 MR. SHUMAKER: That's correct. That's correct. I

12 mean these are issues that came up in the pilot, and I

13 really -- we might want to talk about some examples of those

14 when we talk about the pilots.

15 DR. APOSTOLAKIS: That's fine. That's fine. No,

16 I am just --

17 DR. POWERS: The elections that you make here

18 between deterministic and performance-based to avoid right

19 and left, since it is just different for the people in the

20 front of the room than it is for other people, are made --

21 can be made on a issue by issue basis?

22 MR. HENNEKE: Feature by feature, really. I mean

23 if you are talking about a wall or a sprinkler system, --

24 DR. POWERS: Feature by feature.

25 MR. HENNEKE: -- detection, you are really looking

1 at it for a feature, but you could handle it from a room by
2 room, however you like. But, typically, for a feature by
3 feature.
4 MR. NAJAFI: Actually, there has been some thought
5 about to be careful not to jump from one side to the other
6 side as it goes from issue to issue. But I think there is
7 more than just one factor that determines which way you go.
8 It is dictated by where you stand in your licensing basis
9 currently, and what is the issue at hand, what is the
10 motivation, and whole bunch of other things, in addition to
11 the technical issues that tells you which way you go.
12 DR. POWERS: Have people explored in some care and
13 detail what kind of conflicts are likely to emerge if one
14 does balance between sides, between the deterministic and
15 the performance-based?
16 MR. NAJAFI: I don't know exactly where you are
17 going with the question.
18 MR. EMERSON: Dana, if you are talking about
19 having one licensing basis for one fire area and another
20 licensing basis where, you know, the staff has made it
21 pretty clear that that is not an appropriate use of the
22 standard, then we would agree with that. Rather than mixing
23 licensing bases, what I think the staff intends is that
24 people who make partial use of the standard make use of
25 specific tools to support specific exemption requests, not

1 mixed bases for areas.

2 DR. POWERS: I could see, you know, I could see

3 that one might find attractive using different sides of the

4 diagram for things like circuit analysis, which covers lots

5 of fire areas, as opposed to looking at the fire area and

6 the fire barriers and whatnot in there, just because it

7 probably would be easier.

8 But if you went from fire area to fire area, I

9 would think that that would be just uninspectable.

10 MR. EMERSON: You can't do that. The staff has

11 made that very clear.

12 DR. POWERS: But the standards, I mean, doesn't

13 make it clear.

14 MR. NAJAFI: It is true that it is going feature,

15 as Dennis said, going across feature from left to right, it

16 may be easier, I mean because of the dependencies across the

17 areas. But, still, I think there is -- I mean there has

18 been a lot of caution against jumping from one side to the

19 other side.

20 DR. POWERS: I mean the caution doesn't appear in

21 the standard. The standard is pretty clear, you can pick

22 and choose here. And it seems to me that that just seems

23 fraught with -- I mean it seems to me it renders the

24 standard uninspectable is what it does. I mean how many

25 inspectors are going to be able to -- I just walked through

1 a door, now I completely changed my mindset. It is just --
2 MR. EMERSON: Well, that is where the implementing
3 guidance comes in and explains, a standard wasn't --
4 DR. POWERS: What kind of guidance are you going
5 to be able to write to a guy that says, look at one pump one
6 way and look at the identical pump in a different,
7 fire-related, in a completely different way?
8 MR. NAJAFI: Well, I guess my point was at this
9 point it is not clear that even you can do that. I am
10 saying that that may be something you should not, or
11 cautioned against doing, at least mixing.
12 DR. POWERS: Well, at least in my version, and I
13 don't know whether my current version is the latest and the
14 greatest, I don't seem to have that kind of caution.
15 MR. HENNEKE: I don't think it specifically states
16 that.
17 MR. NAJAFI: I think that's correct.
18 MR. SINOPILI: And Fred is right, I think that was
19 one of the thoughts of the committee, that there be,
20 regardless of who adopts this, whether it is the United
21 States or whether it is France or whoever, they would have,
22 in that particular authority having jurisdiction, would
23 develop some sort of implementing document to make it, as
24 they adopted it as their standard that they would use.
25 DR. APOSTOLAKIS: Yeah, the only words I found, I

1 got help from Jit, in the standard is the authority having
2 jurisdiction, if one follows the right -- I mean the
3 performance-based approach, should accept or should find the
4 models that you are using acceptable. But I couldn't find
5 anything, we couldn't find anything on the probability of
6 meeting the performance criteria themselves.
7 Anyway, this is not the time to look for it. But,
8 you see, that may, in fact, be a little bit misleading to a
9 licensee because he might say, well, gee, they have Nathan
10 Siu there, they have been doing combinant calculations, that
11 is clearly acceptable, so they go that way, and they do not
12 suspect that it is not just the code you are using, that,
13 ultimately, there will be a question of what are the
14 probabilities that are acceptable, the probabilities of
15 meeting the performance criteria.
16 MR. NAJAFI: This is what Section 2341 reads.
17 DR. APOSTOLAKIS: Okay.
18 MR. NAJAFI: Risk acceptance criteria. The
19 changing public health risk from any plant change shall be
20 acceptable to the AHJ. CDF and LERF shall be used to
21 determine the acceptability of the change.
22 DR. APOSTOLAKIS: And I am saying I am not talking
23 about changes. For changes, I know, I have Regulatory Guide
24 1.174. There is a big distinction between proposing a
25 change to the plant and doing it as is. It is a big

1 difference.

2 But I suggest, Mr. Chairman, we continue.

3 MR. SIEBER: Yes, please.

4 MR. SINOPILI: Okay. Again, as part of the

5 overview, and I will discuss Chapter 3 in detail.

6 DR. APOSTOLAKIS: You will not discuss the next

7 figure, or somebody else will do that?

8 MR. SINOPILI: Well, I was going to --

9 DR. APOSTOLAKIS: I don't have any comments, but

10 maybe Mike or Jack.

11 MR. SINOPILI: In the interest of time, this

12 provides information within Chapter 2 for doing engineering

13 analysis. And it gives you basically a flow chart on how to

14 -- it gives various steps, and is relatively detailed, to go

15 through. But it gives you a framework for doing your

16 performance-based engineering analyses.

17 DR. APOSTOLAKIS: So I guess what I am saying is

18 that your bottom diamond there could be a problem. Can

19 performance requirements be satisfied for these fire

20 scenarios? Now, if you can answer that question, then you

21 have answered mine.

22 Okay. Let's go on.

23 Chapter 3 is what we call the fundamental

24 requirements and those are the things that -- let me use a

25 quote -- are the sacred cows of the fire protection

1 community. They are deterministic. That was the intent of
2 the committee from the beginning.
3 There is a provision there to accept previously
4 approved configurations and again I will talk about that in
5 a few more minutes.
6 The chapter addresses the traditional fire
7 protection program, prevention, control of combustibles. It
8 addresses the fire brigade, the training requirements for
9 the fire brigade, the staffing levels and also what I call
10 fire protection system hardware, fire water supplies, fire
11 detection, suppression systems as well as fire barriers.
12 Chapter 4 is determination of required fire
13 protection systems and features and this is somewhat similar
14 to Appendix R. It established the methodology to determine
15 what fire protection systems would be needed to protect a
16 specific feature or system to meet the goals and objectives
17 and it does required that one success path remain free of
18 fire damage for any single fire.
19 As one would expect, it allows the use of either
20 performance based or deterministic approaches and it
21 references back to Chapter 2 for the methodology on how to
22 perform the analysis.
23 At the risk of generating questions, I will go
24 ahead and put up the flow chart.
25 DR. APOSTOLAKIS: But you have an acceptable risk

1 in your mind.

2 MR. SINOPILI: No, I figured the acceptable risk

3 is he's sitting next to me and he can answer the question.

4 [Laughter.]

5 MR. SINOPILI: Again it has the proverbial right

6 side and left side, deterministic or performance-based

7 approaches.

8 Chapter 5 provides fire protection requirements

9 for plants that are going decommissioning or permanent plant

10 shutdown. This is essentially a deterministic approach for

11 plants that are going through decommissioning.

12 Basically what it uses the goals and criteria is

13 determining at what point you can stop fire protection

14 requirements.

15 DR. POWERS: It seemed awfully restrictive for

16 some reason. I can't remember what all you said exactly.

17 MR. SINOPILI: It's very restrictive.

18 DR. POWERS: "And shall continue to maintain a

19 fire protection plan as specified in Section 3-1" and I

20 assume that is all of it, 3-1, period.

21 MR. SINOPILI: Yes.

22 DR. POWERS: Throughout decommissioning?

23 MR. SINOPILI: Until they reach a point where you

24 can demonstrate that you no longer have to meet the goals,

25 objectives and criteria. In other words, you have removed

1 the hazard that would give you either a radioactive release
2 hazard or nuclear safety hazard.
3 Just briefly, Chapter 6 is a standard NFPA
4 documents that are actually referenced in this document.
5 As far as the rest of the references, Appendix F
6 provides all the other non-NFPA documents that are
7 referenced and in some cases there is enough information in
8 the text that gives reference information that they aren't
9 referenced again, but the bottom line is there are
10 references throughout Chapter 6, Appendix F and in some
11 cases in the text.
12 Appendix A supplies the explanatory material and
13 in fact if you go through the body of the text any time you
14 see an asterisk you find a direct correlation between the
15 information in the asterisked section in the body of the
16 standard back to Appendix A.
17 DR. POWERS: If it is of any interest to you at
18 all, I found that impossible. Every time -- first of all,
19 the asterisks are small enough that I missed them, and then
20 I would go to the Appendix and I would read the thing and
21 then I would have lost my place.
22 MR. SINOPILI: Well, for good or for bad that's
23 standard throughout any NFPA standard --
24 DR. POWERS: I know it is.
25 MR. SINOPILI: -- whether it is sprinklers or

1 detection. That's their manual of style.

2 The important thing, as I mentioned earlier --

3 DR. POWERS: Footnotes just work so wonderfully

4 for these -- especially since they were all just little -- I

5 mean there were very few of them that went over a few lines.

6 MR. BIELEN: That won't be going away in the near

7 future. We just revised the manual style and they left that

8 concept in there so that's something we are going to have to

9 live with for a long time, at least in the NFPA process.

10 MR. SINOPILI: But the key to the Appendix

11 material is whatever is in there is not enforceable and one

12 thing that the committee did is we had discussions should

13 this be required, is it good information and quite often the

14 fall-back position was yes, we all agree it is important but

15 is it enforceable and we would vote no and we would put it

16 in the Appendix.

17 That is why in some cases there is quite a bit of

18 information back there.

19 That same philosophy also falls through the other

20 appendix because the remaining appendix that I will be

21 talking about are not enforceable. They are there for

22 information purposes only.

23 Appendix B in my mind is very similar to Appendix

24 R, Sections G and L. It provides the nuclear safety

25 assessment. It gives the safe shutdown information you

1 would do through a normal Appendix R type analysis --
2 reactivity control, inventory and pressure control -- you
3 can read those up there, but it is very similar to what we
4 have and Fred, I guess you will be talking about this later
5 in more detail.
6 Appendix C talks about fire modeling and in this
7 section it gives an overview of what fire models are, some
8 of their limitations, where they are appropriate and then it
9 runs through some sample fire scenarios, gives you some
10 information on types of uncertainties if you are using fire
11 models you should keep in mind and gives some references to
12 the various fire models that are currently available and
13 again I believe Bijan is going to be talking about that in a
14 little more detail.
15 Appendix D is the PSA section which Dennis will be
16 addressing in more detail in a few minutes, but basically it
17 describes in Appendix D what would be an acceptable approach
18 for doing a fire PSA to fulfill the requirements of 805.
19 Appendix E is the more traditional fire protection
20 information for business interruption, fire damage. A lot
21 of this information used to be in NFPA 803, which was a
22 non-safe shutdown but it had a lot of good practices for the
23 balance of the plant type fire protection.
24 A lot of the information there came directly from
25 either 803 or from the insurance companies.

1 To summarize the overview real quick, I think
2 without question NFPA 805 has been a start. I think we have
3 improved the document each time we have worked on it and
4 again we seemed to have made big revisions each time we have
5 met.
6 I think the NFPA process -- not only do we have a
7 revision cycle but the equivalency provision in there allows
8 us to incorporate improvements, new tools as they become
9 available.
10 However, I think if you go back to the original
11 SECY letter where we talked about and the Staff talked about
12 what some of their goals were -- for example, that you would
13 set high level goals but not be prescriptive in how to
14 implement the goals in the methodology -- I am not sure if
15 we have quite satisfied that.
16 It's obviously still a very deterministic
17 standard. I think some of the requirements that are
18 marginal to safety remain and again a lot of those are in
19 Chapter 3, which I will talk about, and some new
20 requirements even though they may not be new in terms of
21 being on the books for some plants. If you look to their
22 licensing basis they are in essence new and again Chapter 3
23 is where most of those are.
24 If there's no questions I will go right into
25 Chapter 3.

1 Chapter 3 provides directions for the people using
2 the standard for what is considered the traditional or the
3 fundamental aspects of the fire protection program.
4 It talks about things like who is responsible for
5 what for fire protection, your combustible loading
6 requirements, your ignition source controls. It also
7 provides information on fire protection systems, fire pumps,
8 fire water supplies, detection, suppression, and fire
9 barriers.
10 As was the intent of the committee the approach in
11 Chapter 3 is deterministic and prescriptive in nature.
12 Chapter 3 requires you to develop a fire
13 protection plan and that plan would include such things as
14 who is responsible, what administrative controls have to be
15 in place, the controls for specific fire hazards such as at
16 a PWR the reactor coolant pumps for transformers and also
17 specific ignition source controls, hot work permits for
18 example.
19 It requires that a site fire brigade of a minimum
20 of five members be established and also the training periods
21 for both drills and for classroom training.
22 It provides information on the site water supply
23 requirements for fire protection, the number of fire pumps,
24 the water supply capacity.
25 It requires a sandpipe and hose station system be

1 provided.

2 If you are required it per Chapter 4 and you are
3 going to be installing detection suppression systems it
4 gives you the required NFPA code that would go along with
5 that and in certain cases where we thought, where the
6 committee felt that there were some requirements associated
7 with that type of system be on, the minimum required by the
8 associated NFPA code they provided those.

9 An example would be if I had a CO2 Cardox system,
10 right now the Cardox standard says you should not install it
11 in normally occupied areas. We felt that at a nuclear power
12 plant we didn't want it installed in a normally occupied
13 area so we made that a "shall" requirement so there were
14 some options that we went beyond the minimum that's
15 required.

16 For the most part Chapter 3 mirrors existing NRC
17 requirements. As a result some plants would be seeing new
18 requirements because a lot of those requirements were
19 promulgated after a lot of plants had their licensing basis
20 already in place. For example, I would say that most plants
21 out there are going to find at least one part, at least one
22 section of Chapter 3 to cause them to look at new
23 requirements.

24 DR. APOSTOLAKIS: And Chapter 3 again is the
25 deterministic approach?

1 MR. SINOPILI: No, Chapter 3 would be the
2 fundamental fire protection program. The old insurance
3 stuff would be typically what it would have been called.
4 DR. APOSTOLAKIS: So it is not in the figure you
5 showed.
6 MR. SINOPILI: Yes, it's at the very top.
7 DR. APOSTOLAKIS: Establish mandatory protection.
8 MR. SINOPILI: Right.
9 DR. APOSTOLAKIS: And the industry did not fight
10 this? Interesting.
11 DR. POWERS: Let's chat just a little bit about
12 that mandatory protection.
13 For instance there's a requirement that fire
14 hydrants are every 250 meters or something like that, not
15 249, 246 -- 250 meters. 250 feet, exactly. I'm sorry,
16 feet.
17 What conceivable justification for such precision?
18 Presumably maybe you can have them every 125 feet but you
19 can't have them every 251 feet.
20 MR. SINOPILI: I can't speak for everyone on the
21 committee and part of the feeling of the committee was
22 twofold. One, we didn't want to create a standard of
23 minimal compliance. There was a feeling out there that
24 there are certain things that are important.
25 Separation of fire pumps, for example, that if you

1 are going to have fire pumps in the same room they should be
2 separated even though they may be --
3 DR. POWERS: No, those more qualitative things
4 they are much more tolerant of, but the ones that seem to
5 preclude any engineering analysis -- by god, 250 feet, not
6 251 but 250 feet -- they a bit surprise me.
7 MR. SINOPILI: Yes, I would agree.
8 DR. POWERS: It's right for me to be surprised
9 then?
10 MR. SINOPILI: Yes. For example, a lot of plants
11 right now don't have fire hydrants that are separated every
12 250 feet or they may not have separation for all their fire
13 pumps, as we discussed, and what makes this particularly
14 bad, even though there is a provision in Chapter 3 that says
15 if you have a previously accepted, previously approved
16 licensing basis that sets it at 251 feet then 251 feet would
17 be acceptable.
18 DR. POWERS: Sure.
19 MR. SINOPILI: The problem is in some cases they
20 may not have specifically addressed spacing of fire hydrants
21 in their licensing basis so the NRC would come back now and
22 say gee whiz, it's 251 feet and under 803 that is not
23 acceptable. That's putting the example a little strictly
24 but --
25 DR. POWERS: I am sure on that one somebody could

1 figure out a way to give an exemption on that.

2 MR. SINOPILI: But to follow that thread, yes,

3 what you are saying is true and again because you just said

4 that, but how did the industry feel about that, and the

5 feedback that the industry, that I have gotten from the

6 industry, and I think Fred would agree, that this appears to

7 be an obstacle for some plants to adopt this standard should

8 it become available for them to do it.

9 Also there is a feeling out there that there's not

10 a lot of technical basis for this.

11 Another example is why do we have, in a nuclear

12 power plant why do we have to have control of all the fire

13 valves? We have valves on water systems that are probably

14 much more critical to safe operation of the plant than fire

15 valves that we don't have supervision at the same level we

16 do for fire protection.

17 Again I am not saying it is good or bad. That's

18 just an example.

19 Another example is seismic requirements for hose

20 stations.

21 DR. POWERS: Maybe it is the proof of one of those

22 rules "Never ask an expert unless you can live with the

23 answer."

24 MR. SINOPILI: However, the committee has

25 consistently voted to keep Chapter 3 prescriptive.

1 There was a comment that went through that
2 suggested a less prescriptive approach, and that was soundly
3 defeated almost on a point by point basis.
4 DR. APOSTOLAKIS: You didn't know you were
5 structuralists to the bone. That's the first time you hear
6 that word?
7 [Laughter.]
8 MR. SINOPILI: The committee consider these to be
9 fundamental requirements and again there was a concern with
10 creating a standard that was the least common denominator.
11 We figured out which plant was the worst in each
12 case and that is what we would adopt and that was one of the
13 feedback --
14 DR. APOSTOLAKIS: So having a fire brigade
15 consisting of at least five people is a fundamental
16 requirement?
17 MR. SINOPILI: Yes.
18 DR. POWERS: On that particular one, isn't there
19 some OSHA standard coming down on fire --
20 MR. SINOPILI: Five is probably a good number
21 simply because you have to have a leader and then two and
22 two out rule -- two people in and two people out.
23 DR. POWERS: So multiple lines of attack are
24 precluded here for manual firefighting.
25 MR. SINOPILI: So five is really in essence

1 probably the minimum number, if you start looking at it.
2 DR. APOSTOLAKIS: What do you mean two in, two
3 out?
4 DR. POWERS: Two people can go into a structure
5 but there have to be two people outside in case those guys
6 get in trouble? It's a new OSHA standard. It seems to
7 create a headache here, because in some case you would like
8 to have people going in to fight a fire from two directions
9 in case one of them is blocked.
10 MR. SINOPILI: Or to protect an exposure.
11 DR. POWERS: Reduce the exposure, yes.
12 MR. SINOPILI: Just for brevity, because we have
13 really gone on, I have some specifics here and if you don't
14 mind I basically have said all the specifics so I will just
15 go on to the last slide here.
16 Again just to summarize what I just said over the
17 last couple of minutes, without question this chapter
18 remains prescriptive and I must say that the committee has
19 consistently voted to keep it this way and as a result
20 there's going to be some new requirements for certain
21 plants. In fact, most plants out there will see -- again, I
22 hate to use the word "new" because the requirement is
23 already on the books if you look at the latest NRC
24 regulations, for example NUREG-0800, but for the older
25 plants the Appendix A plants for example they would not have

1 that specific requirement in their licensing basis.

2 As a result, a lot of plants may have difficulty

3 in adopting the standard the way it is written right now. I

4 think Dennis may talk a little bit about some of the

5 problems that they had in the pilot along those lines.

6 Any questions? And I apologize for taking so

7 long.

8 DR. POWERS: Don't worry about that.

9 DR. APOSTOLAKIS: It wasn't entirely your fault.

10 [Laughter.]

11 MR. SINOPILI: I had to put up that slide.

12 MR. HENNEKE: Okay. I am going to talk about the

13 PRA section and the PRA section is really in a couple of

14 places. It's fairly brief in the standard so I will be

15 brief, and you should have one page front and back are the

16 entirety of my slides.

17 DR. POWERS: A crafty individual -- fewer slides

18 and fewer questions, right?

19 MR. HENNEKE: All right. The fire risk

20 evaluations using PRA are discussed in the Section 2.3.3.

21 Basic requirements are that when you use PRA as a support

22 for the performance based approach or in analysis of a

23 performance based change that you will analyze both CDF and

24 LERF. It is pretty consistent.

25 You will include all potentially risk significant

1 fire scenarios associated with that feature, so if you are
2 looking at Kaowool or whatever and it is in a particular
3 room that you will look at all the various fire scenarios
4 with regard to that feature.
5 You will use only methods acceptable to the AHJ
6 and Appendix D provides some guidance and discussion on
7 acceptable methods. However, Appendix D has been touted in
8 numerous discussion groups -- it is not a standard similar
9 to the ASME PRA standard for what is an acceptable fire PRA.
10 It is a very general appendix that just says that a typical
11 fire theory --
12 DR. APOSTOLAKIS: That is a good point. When the
13 issue of PRA quality comes up the standard phrase is ASME is
14 doing internal events, ANS is doing external events except
15 fire because the NFPA is doing fire, but the NFPA is not
16 doing fire the way ANS is doing external events.
17 You are telling us that this is not really written
18 the same way.
19 MR. HENNEKE: That's true and I have talked to at
20 least one or two members --
21 DR. APOSTOLAKIS: So should we tell the ANS to do
22 fires then?
23 MR. HENNEKE: I have talked to one or two members
24 of ANS and told them that, that I heard it repeatedly that
25 ANS doesn't need to do that because in the FNPA standard.

1 DR. APOSTOLAKIS: Yes, that's right.

2 MR. HENNEKE: There is a framework for a quality
3 fire PRA but it doesn't say, for example, that you can use
4 only modeling of this type and that your frequencies for
5 initiation will come from this location that it is or is not
6 acceptable to use five for an acceptable method, and so
7 right now it is, as is the acceptance criteria, the methods
8 need to be negotiated with AHJ or the NRC.

9 DR. APOSTOLAKIS: So you are not addressing PRA
10 quality?

11 MR. HENNEKE: We discussed PRA quality but the
12 quality is set with the NRC and --

13 DR. APOSTOLAKIS: So there's some miscommunication
14 at a higher level then?

15 MR. HENNEKE: Yes. Hence the reason for the
16 bullet -- to make sure that that is straight.

17 As we mentioned before the CDF and LERF's
18 acceptance criteria need to be acceptable to the AHJ. It
19 does include a requirement to discuss defense-in-depth and
20 safety margin evaluations and uncertainty. We tried to keep
21 all our discussions and evaluations consistent with Reg
22 Guide 174.

23 In addition, we added discussion of
24 defense-in-depth in the Appendix A which is over and above
25 what is standard fire protection discussion and there are

1 six bullets in A.2.3.4.2 and it includes a reasonable
2 balance among prevention of fire, fire's early detection and
3 suppression, and the fire confinement is preserved,
4 over-reliance on programmatic activities, things like this.
5 Defenses against human errors are preserved, so there's a
6 whole series of things we talk about that has to be
7 maintained.
8 DR. POWERS: Let me ask this. You have elected to
9 use CDF and LERF as the risk metrics.
10 MR. HENNEKE: Yes.
11 DR. POWERS: Yet the standard itself calls out as
12 one of the performance goals the preservation of health and
13 life of people in the vicinity of the fire, on the site of
14 the fire.
15 Indeed, when we look at 10 CFR Part 50, it is
16 evident that the NRC 50 -- Part 21 as well, that the NRC had
17 in mind in formulating the regulations some protection of
18 the workforce against radiation exposures.
19 Certainly when you think about that in terms of
20 fire as well.
21 I am wondering why you didn't have a risk metric
22 dealing with radiation exposures of the workforce under fire
23 conditions.
24 MR. HENNEKE: Let me clarify a little bit. The
25 PRA analysis is for basically the separation criteria, the

1 nuclear safety part of it, so the life safety part of the
2 standard is not PRA based or PRA risk informed, so the
3 general requirements in Chapter 3 set forth the nuclear
4 safety and the life safety as well as the business plant
5 interruption section, which is one of the reasons why it was
6 so hard to performance base that because you can't just run
7 risk numbers and do CDFs when you have to consider all of
8 those areas, not just nuclear safety.
9 Once we started looking at nuclear safety, just
10 the nuclear safety section of that, that was the standard by
11 which all of the previous risk informed applications have
12 gone and so that is where we left it.
13 Now there is some additional discussion in Chapter
14 4 with regard to releases outside of PRA.
15 DR. POWERS: One of my colleagues not too far away
16 from me, sometimes, would tell you that you can get out of
17 all of these problems if you would just use frequency
18 consequence curves.
19 He is not here to respond to that. Go on.
20 MR. HENNEKE: Frequency consequence curves require
21 a full plan evaluation, which I will discuss in a minute.
22 Next slide. Continuing on on the risk informed
23 approach, George is missing in action here but our
24 assumption on the PRA is that any time you go into the
25 performance based arena it is treated as a change to the

1 basis. Whether it is a physical change to the plant or not,
2 we didn't consider that. It is just a change to your basis
3 and so we considered it a plant change and the PRA
4 evaluation is established similar to other plant changes,
5 similar to the maintenance rule, A-4, or the SDP process or
6 Reg Guide 174 or any of the other risk informed processes.
7 All changes that go through the performance based,
8 whether the initial justification is a detailed PRA analysis
9 or using more standard fire engineering analysis -- that is
10 discussed in the performance based section -- need to go
11 through a PRA evaluation, either qualitative or
12 quantitative.
13 DR. POWERS: I guess this has to be the most
14 perplexing thing. There is an unevenness in the PRA
15 analysis and I can do qualitative or quantitative, okay. I
16 won't launch into a discussion of what I think of
17 qualitative PRAs -- that is qualitatively unprintable -- but
18 be that as it may, we do this incredibly exacting thing for
19 operational states and then we just look at the high risk
20 plant operational states for shutdown.
21 I mean why this unevenness? Why not something
22 that is more uniformly demanding?
23 MR. HENNEKE: Actually that is fairly consistent
24 with what we do at power. At power we look at a whole
25 series of accident scenarios, almost all of the FSAR

1 scenarios but not all, and additional scenarios not covered
2 in the FSAR, so it covers all initiating events that we
3 consider risk significant, and those that we don't, that we
4 initially screen out like meteors, for example, we initially
5 throw away and we never analyze them again.
6 What we are looking at here is we already know
7 from analysis on shutdown that there are evolutions in
8 shutdown that are high risk or on the order of the same risk
9 as you run at full power, so we know those are the ones we
10 want to analyze and the ones that when the water level is
11 at, say, 23 feet above the core, when you have the entirety
12 of the RWST sitting on top of your core you don't have to
13 inject because it's already injected. It's sitting there
14 and you have got seven days of the core damage. There is
15 not need to analyze those or protect in those scenarios.
16 When the fuel goes in the fuel pool again you have
17 about 23 feet above the core, we already know from previous
18 analysis that there is no need to look at those, so we are
19 trying to use what we know already with regard to
20 significant operations and significant evaluations, to limit
21 it to those times when we should analyze.
22 A good example is we are in an outage right now at
23 San Onofre and we are from start to finish going through 24
24 separate plant operational states. If I were to protect
25 from a fire operational standpoint all 24 operational

1 states, including maybe the ones that I could get into at
2 the next outage or the outage after the one I got into two
3 outages ago where I used containment spray as the operating
4 shutdown cooling path, then I couldn't finish it in our
5 lifetime, so we need to limit it somehow and we used
6 knowledge we have already to determine what is risky and
7 what is not.
8 So you jumped into my next bullet, which is we can
9 do qualitative and we can do quantitative. There is
10 guidance in there and it expounds on what is in Reg Guide
11 174 and that is the more certain we are that the risk is low
12 and the lower it would be, the more we can justify
13 qualitative assessments.
14 If we are uncertain that it is below our criteria,
15 or we are close to our criteria, then we have to use
16 quantitative evaluation, so with the qualitative evaluation
17 we have to be fairly certain that the risk is very low.
18 DR. APOSTOLAKIS: I think, Dennis, what is
19 happening here is that we start out by saying all changes.
20 Did you guys have in mind actual changes to the
21 plant when you wrote the standard?
22 MR. HENNEKE: When you were gone, George, I
23 mentioned that the premise of the PRA was that anything that
24 was not deterministic goes through performance based was a
25 change to the plant, whether it is a physical change or a

1 plant change to the documentation. That was the premise of
2 the analysis.
3 DR. APOSTOLAKIS: I read it. I'll have to read it
4 again.
5 MR. SIEBER: And changes include deficiencies in
6 compliance.
7 DR. APOSTOLAKIS: You haven't complied with
8 Appendix R and how you are going to comply?
9 [Laughter.]
10 MR. SIEBER: No, the change is the recognition of
11 the fact that it doesn't comply where under the
12 deterministic mode you believed and documented that it did
13 comply so now you have to justify, you either fix the
14 problem or you justify one way or another leaving it as is.
15 The only way you can do that is on a risk basis.
16 MR. HENNEKE: The two examples that I can throw
17 out that are equivalent to that -- everybody throws 10 to
18 the minus 6 out but that is not what we are using.
19 Reg Guide 174 for example says that -- it has a
20 series of curves and you can go up to 10 to the minus 5 if
21 you can show a number of things.
22 In the maintenance rule, A-4, the NEI guidance on
23 that shows exactly the same thing, that if you can justify
24 going to 10 to the minus 5 then go for it. That is what the
25 intention was.

1 We have, in some plants we have tech specs out
2 there right now that go above 10 to the minus 6, which is
3 the tech spec guidance for five 10 to the minus 7 for tech
4 spec guidance for AOTs and AFW pumps in certain plants might
5 be.
6 Well, that's not a change, but we know that it's
7 not the majority of our risk, so we need to keep it below
8 something, and that guidance is in the NEI guidance as ten
9 to the minus five, and that's similar to Reg Guide 174.
10 So there may be things in the plant that are not
11 physical changes to the plant, that are out there now, and
12 we're having to use this as an evaluation that we may
13 justify up to a ten to the minus fifth for that feature,
14 using Reg Guide 174 guidance.
15 I wouldn't expect we'd want to do that, but if it
16 comes down to it, then the Reg Guide specifically says in
17 the gray area that we can do that.
18 So, we have thought about that consistently, and
19 we know that most plants would use ten to the minus six and
20 ten to the minus second for LERF, but on the exceptions --
21 DR. APOSTOLAKIS: I think it's the other way.
22 That's another thing I wanted to ask. Isn't the allowed
23 delta-CDF, ten to the minus five? The standard says six. I
24 thought it was five, and it's ten to the minus six.
25 MR. HENNEKE: That's the upper range. We tried to

1 keep all changes to the very small region, which is ten to
2 the minus sixth, and if we could justify it from a
3 cost/beneficial standpoint, we can go to ten to the minus
4 five.
5 DR. APOSTOLAKIS: But shouldn't you say that in
6 the standard?
7 MR. HENNEKE: The standard doesn't mention the
8 number, other than some discussion on that in the appendix
9 to Reg Guide 174. The present standard doesn't mention a
10 number.
11 DR. APOSTOLAKIS: So where is it, in one of the
12 other documents, I suppose.
13 MR. HENNEKE: I think you heard it in Fred's other
14 discussion on circuit analysis.
15 Okay, so I mentioned there that shutdown
16 evaluations are going to be required, qualitative or
17 quantitative. I'll summarize that in my last slide, but
18 that's a new requirement.
19 And we don't have standard or even a lot of
20 methodology documents on doing shutdown fire PRAs. We know,
21 for example, initiating events during shutdown are much
22 higher than at full power, but we don't have the data at
23 this point to substantiate that, so if we are going to use
24 the standard, we have some work to do in the area of
25 shutdown.

1 There is not site evaluation required. That was
2 in one of your comments the last time we presented. We have
3 been tossing that around, and that was pulled out of the
4 standard.
5 There is a requirement for monitoring
6 availability, reliability, and performance, and, again,
7 that's Reg Guide 174. It comes straight out of there, and
8 there is supporting documentation required that would make
9 the PRA analysis more of an engineering -- living
10 engineering document, similar to what fire hazards analysis
11 would be for the plant.
12 So, concluding what I was trying to -- the point I
13 was trying to make here that the PRA analysis, when you
14 physically get into it, is consistent with the current Reg
15 Guides and is fairly simple.
16 So it's not too atypical from what we might do in
17 risk-informed tech specs or any other risk-informed
18 application.
19 Analysis of the lower modes is new. As I
20 mentioned, there is little guidance on how to do that. At
21 San Onofre, for example, we have a safety monitor, we have
22 fire in our safety monitor, up to the point of going to
23 shutdown, and then it turns off, and we'd be the first to be
24 doing a shutdown fire PRA, if we could find adequate
25 guidance on how to do that.

1 Some additional guidance over and above what's in
2 Appendix D would be required to determine what acceptable
3 fire methods would be, and which would avoid, basically, NRC
4 approval of PRA methods prior to the application.
5 So you can see us going into using this, and we
6 would declare that we would like to use the standard, and we
7 would immediately go into negotiations with the NRC on what
8 the acceptance criteria is and what the acceptable methods
9 are, which would now require the NRC to do a full scale
10 review of our PRA, and then at great cost to both us and the
11 NRC.
12 So we need to save that cost by setting those
13 standards ahead of time.
14 Lastly -- and I haven't mentioned this. You had
15 mentioned, George, earlier about risk-informing Appendix R,
16 and this was the attempt at doing that. But there is not at
17 the present time a similar to like risk-informed tech specs
18 where you can risk-inform one or more of your tech specs,
19 but not necessarily all of them on a case-by-case basis,
20 called cherrypicking in some locations.
21 There isn't a risk-informed process for taking
22 exceptions to particular fire features. The methods here
23 can be the basis for doing that, if so desired, and so we've
24 hashed out some of the details, and if we wanted to go a
25 different direction, more of a deviation type of approach,

1 then the methods could be used for that.

2 Are there any questions?

3 [No response.]

4 Dijan?

5 MR. NAJAFI: Okay, very basically, I'm going to

6 talk about how the standards deal with the fire modeling.

7 Next slide, please.

8 Fire modeling appears in the standard in a couple

9 of places. Basically, one is for use in the engineering

10 analysis when you're using the performance-based approach.

11 In part, the idea there is that if -- to define

12 the scenarios and determine whether an established

13 performance criteria can be met by basically determining the

14 effects of a fire, what can the fire do?

15 You do that by identifying the equipment and

16 targets that it's required to meet that performance criteria

17 that has been established, established damage thresholds,

18 and define the fire scenarios and then demonstrate how much

19 of a protection, if any, you can provide to those targets.

20 The other area of the standard that uses the fire

21 modeling is in the risk evaluation or change analysis, which

22 appears in Appendix D and in Section 2 as well. And there

23 it's defined how basically to -- the objective of the fire

24 modeling to determine likelihood and impact of postulated

25 fires within different plants and areas.

1 Next, please. Basically, when using fire
2 modeling, the standard requires a set of fire scenarios to
3 be defined for each plant area. I mean, unless you can
4 demonstrate for some reason that either the change or
5 basically those areas are unaffected by your basis, but
6 basically you need to establish adequate fire profile,
7 hazard profile for every area that is covered by that
8 performance requirement.
9 These fire scenarios have to establish the
10 conditions under which a proposed solution is expected to
11 meet the performance criteria, whatever you're trying to
12 establish.
13 And these fire scenarios, the unique -- I mean, we
14 talked before about design basis fires. One of the
15 conditions that's going to come out of using these kinds of
16 approaches, is that once you establish those kinds of
17 routes, these fire scenarios become your design basis fire
18 for that fire area to meet that performance criteria.
19 So, basically these may end up replacing what the
20 design basis would have been for Appendix R fires, which is
21 basically defined according to the fire area boundaries that
22 you establish.
23 DR. APOSTOLAKIS: So instead of design basis
24 accidents, you would have design basis scenarios?
25 MR. NAJAFI: Design basis fires, because

1 everything that you -- whether you are designing a fire
2 protection feature system, or you're establishing a criteria
3 to be met, you have to say that what kind of fire? You have
4 to look at all kinds of fires and say, I have met that
5 design condition or performance condition.
6 DR. APOSTOLAKIS: But I don't do that by looking
7 only at the fire; I have to look at the systems, separation
8 criteria
9 MR. NAJAFI: Yes.
10 DR. APOSTOLAKIS: So you're redefining the design
11 basis scenario.
12 MR. NAJAFI: Scenario. Well, yes, it is true that
13 there is a little bit of a difference in how you define a
14 fire scenario. When I talk about fire scenarios, it starts
15 from inception of the fire to basically the impact on plant
16 systems and personnel.
17 I cover that along -- I mean, in a traditional
18 fire community, when you get to the damage, that's where the
19 fire scenario stops.
20 Generally, when this standard was developed, we
21 have tried to extend the definition of a fire scenario, and,
22 in fact, in Appendix C, it's reflected as including the
23 impact of the fire on plant systems and operations. So
24 that's the fire scenario.
25 So, basically this is something that -- what we're

1 doing here, we're establishing new basis for these fires.

2 MR. ROBOSKI: Andy Roboski, South Carolina. Are

3 you talking about a fire scenario for each fire area, or

4 each fire zone?

5 MR. NAJAFI: Those are the things that are defined

6 by the performance criteria that you want to satisfy. So if

7 you're defining these performance criteria -- for example,

8 part of that is to -- in the previous slide, to define you

9 equipment and targets.

10 If that equipment and targets are defined per your

11 fire area, then the scenarios that you establish are per

12 area, the fire area that you have basically defined your

13 performance criteria for.

14 So, in a way, basically, it gets away somewhat

15 from this E-119 fire design or the three-hour fire type of

16 boundaries. That's one unique nature.

17 The standard requires you to calculate basically

18 two kinds of scenarios which I will explain a little bit

19 more. It's a maximum expected and a limiting fire scenario.

20 And also the standard does not require you to

21 define these fire scenarios concurrent with other design

22 basis events, unless they are caused by fire, such as LOCA,

23 ATWS or other events, or to be concurrent with other severe

24 accidents such as, again, seismic or other events.

25 Next, please. Basically, a fire scenario shall in

1 this standard, require that a fire scenario should consider
2 all different operational conditions. And basically it
3 should cover a wide range. I made a list of some of them,
4 but this list basically included both in Section 4 of the
5 standard and in Appendix C of the standard, basically covers
6 all different phases.
7 It includes the initiation phase that provides
8 instructions that you have to account for various
9 combustible materials in an area, ignition sources,
10 geometry, location, and all that kind of stuff.
11 So, this is plenty of these kinds of instructions
12 are provided to define the scenarios.
13 The next step is, once you have defined the fire
14 scenario, is the evaluation. The standard provides a great
15 deal of detail in Appendix C about the available models to
16 evaluate these, and maybe some description of their
17 limitations or capabilities.
18 But basically it requires you that the models have
19 to be acceptable to the AHJ; the models shall be applied
20 only within their limitations, and the models should be
21 verified and validated.
22 But what is currently not in this version in the
23 same level of detail in the standard of Appendix C in terms
24 of guidance, is how to select and use and basically
25 references for input data in terms of the characteristics of

1 fire hazards, materials, and all that kind of stuff.

2 And, in fact, I'll mention again that there is

3 another -- in parallel with this standard, SFPE developed

4 another design performance-based fire design guide, which in

5 that one, basically when it comes to this section, there's a

6 stand-alone basis reference list that provides guidance in

7 the Appendix on where to get this data which could

8 potentially be added at some point to this.

9 Next slide, please. There are references in the

10 standard in how to deal with the uncertainties of the fire

11 modeling. There are primarily -- the maximum expected and

12 limiting fire scenarios, the objective was as one way to

13 deal with the uncertainty in the fire modeling itself.

14 The maximum expected scenario is defined based on

15 -- is basically the scenario that you expect or -- is based

16 on the available data in the scenario that you would

17 anticipate to occur within an enclosure.

18 And then limiting fire scenario, you will take the

19 parameters that were within that fire scenario and find the

20 lowest margin that will cause violation of the performance

21 criteria.

22 The idea with that was to find out, for example,

23 if your scenario defines in that area, a 200 kilowatt fire,

24 you want to know if the margin is that if I change that 20

25 to 220, if it causes a violation of the performance

1 criteria, that shows inadequate or potentially inadequate
2 margin.
3 So that was one way of trying to provide a means
4 of reasonable assurance and confidence in your results.
5 Obviously, there is a great deal of writeup also
6 in the appendix that talks about sources of uncertainty in
7 the fire modeling, that can be systematically propagated and
8 used, using sort of existing methods. There is no new
9 approach or methodology that it's being introduced in that
10 area in this document.
11 Next one, please. The next -- I just want to --
12 this is basically the composition of the subcommittee that
13 developed the fire modeling part of it.
14 Basically, there was a diverse group that
15 represented people who have developed methods, who have been
16 involved in use of the methods and different applications of
17 the fire modeling, and the people have prepared submittals
18 and reviewed and all kinds of things.
19 So provided the first group to help develop the
20 technical basis and what is needed to -- that it's an
21 implementable approach.
22 Next, please. I want to close with these
23 basically three thoughts: One is that fire modeling has
24 been used under existing rules in the past, and will be used
25 in the future as an integral part of the fire protection.

1 It's been used years and years, whether it's in a
2 very simplified way of putting 20,000 btu's per square foot,
3 which has been used back and forth as a size or measure of
4 determining the impact or the damage a fire can do, or more
5 sophisticated examples in design of fire protection programs
6 under developing the standards and codes.
7 In addition, current fire protection programs are
8 developed either directly or indirectly to provide
9 protection against possible fires and their impact. In
10 other words, fire scenarios.
11 So that practice has been inherent in what has
12 been going on in fire protection so far. What 805 brings to
13 the table basically defines or provides a more explicit role
14 of fire protection in plant basic analysis, design, and
15 performance measurement.
16 It provides -- it will provide more transparent
17 links between how these fire modeling basically impacts
18 plant operation, where it has been used.
19 The last point I want to make is that basically
20 this issue about the deterministic or prescriptive versus
21 performance-based, it crosses also through the fire modeling
22 as well.
23 Right now, the standard, the way it's written, the
24 fire modeling is used to support basically both methods.
25 There are references for the fire modeling to be used to

1 demonstrate the equivalency for the three-hour protection,
2 for example, and at the same time, the fire modeling is used
3 to demonstrate performance criteria of adequate for the kind
4 of hazard in addition to be used for determining the fire
5 risk associated with a plant design or status.
6 So, basically, this issue about the prescriptive
7 and performance-based is not something that it's part of the
8 fire modeling. I mean, it has its role, and 805 brings a
9 good role for fire modeling to be used in more explicit way
10 in fire protection.
11 I mean, that's all I wanted to say. If there are
12 any questions --
13 [No response.]
14 MR. EMERSON: I am going to go through the
15 discussion of circuit analysis, and given the time, I'm
16 going to keep it very brief, and just make a few points.
17 Slide 3, please.
18 Now, circuit analysis is a portion of what the
19 standard calls nuclear safety capability assessment. And
20 there is a list of four steps there that are intended to be
21 performed, all of which have to be achieved to meet the
22 performance criteria that were established earlier.
23 And one of those three steps, you'll see, is
24 systems and equipment, circuit analysis, equipment cable
25 location, and fire area assessment that you will notice is

1 very similar to what Tom Gorman talked about this morning
2 from the owners group's standpoint.
3 Now, that's the requirement in the body of the
4 standard, and Appendix B performs considerations in
5 performing those steps.
6 Now, you can use either a performance-based or
7 deterministic approach. The deterministic case-specific
8 requirements are identified. In a performance-based, you
9 have to meet the overall criterion that circuits and
10 components have to be maintained free of fire damage.
11 Now, Appendix B, as I said, provides
12 considerations in performing these analyses. I'm not going
13 to try to go through them, but especially in Sections B-3
14 and B-5, they identify the steps to be taken.
15 I'm going to try to summarize the next few slides
16 fairly quickly, and this is going to try to answer the
17 question you raised earlier.
18 There are a number of cases where the NFPA 805
19 guidance varies from the deterministic guidance you've heard
20 about earlier today. And those are listed on the next
21 several slides.
22 The concern we have is not so much that they are
23 new requirements, because if you're adopting a new standard,
24 you might expect some additional requirements, over and
25 above the ones you've already had under Appendix R space.

1 The only concern we have is that sometimes there's
2 a potential for this to be used as the standard by which to
3 judge other methods.
4 And since this goes beyond current licensing
5 bases, we just didn't think it would be appropriate to do
6 that. So, this is what, if you want to call it that, good
7 practices, best practices, or whatever, but it's not -- we
8 don't think it should be used to judge the way it's
9 currently done, or the way it's being developed by the
10 owners group or by NEI.
11 And basically, this is the point I didn't get to
12 make adequately this morning, or maybe I did. We think that
13 the NEI guidance is the best way to do that. That refers
14 back to what I said this morning, but the 805 guidance,
15 again, shouldn't be used as a standard to judge that.
16 And those were basically the points I wanted to
17 make. That's it.
18 DR. POWERS: Could that concern be something new
19 to judge something old, to the detriment of something old.
20 I think it's real. I mean, I don't discount the concern.
21 But I wondered if it isn't a prescription for
22 stagnation; that is, you never raise anything new if your
23 concern is that it's going to affect something old or the
24 perception of something old.
25 MR. EMERSON: Well, I guess we've had this

1 discussion with the staff in some meetings we've had with
2 them in the last few months.
3 We think that -- and I'll just speak for the NEI
4 guidance and not for the owners group guidance -- we feel
5 like that's not just something old; it's a rather
6 progressive way to address circuit analysis.
7 And if the methods that we have in that are being
8 used or being judge by what's in the 805 guidance, it
9 doesn't feel like that was appropriate.
10 The 805 guidance, which I didn't really say is
11 deterministic, it's not risk informed, and judging a
12 risk-informed method by deterministic and prescriptive
13 methods, doesn't seem the most appropriate.
14 MR. HENNEKE: One comment on that, and having been
15 involved in both areas, the NFPA guidance that's provided
16 was not changed to either the NEI guidance or the BWR
17 guidance, because the time we developed them, those were not
18 ready for public use or ready for prime time.
19 So, because we put this method in the appendix, I
20 mean, we don't feel it's a better way to do it; it's just
21 that we hadn't done the research and the testing and so on
22 to put a better method in there.
23 So once that's developed --
24 DR. POWERS: Well, they're still a ways away from
25 doing the research and whatnot. I mean, they all have

1 studies still in progress.

2 MR. HENNEKE: So we felt it was the best way to

3 go, even though it may be quite conservative, actually.

4 That's why it's in the appendix. It wasn't the intention of

5 the committee to force everybody to do this, but that was at

6 least a way that could be used that everybody agreed upon.

7 And if there are alternate ways, we knew they

8 would surface in the next few years.

9 MR. EMERSON: Thinking about what I just said, it

10 sounds like I don't want to be judge adversely, but if you

11 read the provisions of the 805 circuit analysis guidance, it

12 tells you what to consider, what not to consider, and some

13 of those require you to consider more than spurious

14 actuation.

15 Now, that may not be inherently bad, but to me

16 it's less adequate than taking a risk-informed view of

17 whether more than one spurious actuation at a time is

18 significant or not.

19 It's making a judgment without knowing the

20 significance.

21 MR. SHUMAKER: I'm Dennis Shumaker and I'm a Fire

22 Engineering at Hope Creek Generating Stations, and I'm here

23 today to talk about the EPRI pilot at Salem. Dijan is the

24 Project Manager on that, and he's here on my right, so he's

25 here as well.

1 I'm going to ask Cliff to go to Slide 4, and in
2 the meantime, I'm going to identify that the pilot is a work
3 in progress. It's right on schedule to be completed in
4 November.
5 And basically we'll be reporting the lessons
6 learned to date. I think most of the lessons from the pilot
7 are on the table at this point, but I will identify that it
8 is a continuing project as well.
9 And I kind of wanted to sell my thoughts as
10 risk-informed performance-based, and that's on page 3, and
11 you can look at that at your leisure.
12 Why pilot? We wanted to test drive the standard
13 to identify its completeness, its practicality or
14 practicalness, it cost effectiveness and its useability,
15 both in whole as a replacement license or in part for
16 justifying modifications, exemptions and deviations.
17 Why Salem? Briefly, as George alluded to earlier,
18 we have about 6,000 linear feet of wrap that needs to be
19 upgraded, that has fire resistances under 60 minutes. Some
20 of them are 40 minutes, 50 minutes, 55 minutes, 58 minutes,
21 and when you look at the combustible loads, the room
22 geometries and things like that, it looked like a good idea.
23 We did a feasibility study and looked at the 18
24 fire areas we had in the plants and determined that there
25 were a number of areas that had a high success potential,

1 and, quite candidly, I would rather put the money where I
2 can get real risk benefit instead of trying to upgrade wrap
3 in those areas.
4 With respect to the NFP-805 pilot, the elements
5 exercise, basically, we looked at two performance goals. We
6 talked about those earlier, nuclear safety and radiation
7 release. We did not pilot life safety or the property
8 damage and business interruption sections. And the elements
9 we exercised were the fundamentals, which we have talked
10 about, fire modeling, change analysis, other modes of
11 operation, radioactive release and programmatic issues.
12 And the products we had from the project are
13 basically recommendations to the NFP-805 committee. We have
14 made those recommendations. And, also, there will be an
15 EPRI report that will be published at the end of the project
16 in the November timeframe.
17 MR. NAJAFI: The end of the year.
18 MR. SHUMAKER: End of the year, okay. I will talk
19 about fundamentals briefly. Basically, the standard
20 requires that you meet certain fundamental requirements.
21 Again, we talked about those a little bit, they are a
22 minimum design requirements. Some people consider them kind
23 of your key to get into 805. And the standard does say that
24 where something is previously approved, that that takes
25 precedence.

1 DR. POWERS: There has been discussion of that
2 particular clause and how it is interpreted. Could you tell
3 me how you interpreted that particular clause?
4 MR. SHUMAKER: Yes, I would interpret it that,
5 basically, if the NRC had previously reviewed as part of
6 your license review process an element, say, fire water
7 pumps that were separated or not separated with a three-hour
8 fire barrier, but had adequate separation, and that was in
9 our licensing paper, then that would be considered an
10 acceptable exception.
11 DR. POWERS: Would you extrapolate it anywhere
12 except for those particular pumps that had been -- whose
13 locations had been approved by the NRC?
14 MR. SHUMAKER: I would suggest that if that same
15 configuration existed and that requirement wasn't there
16 before, and, therefore, the NRC never reviewed and approved
17 it, although they, by inference, accepted it, I would not
18 consider that to be covered under that clause. That would
19 be my understanding of that clause. Did that answer your
20 question?
21 DR. POWERS: It is not very clear on the
22 extrapolation.
23 MR. SHUMAKER: I understand. I understand, and
24 that is what -- you are right.
25 DR. POWERS: All right. You have taken a very

1 conservative and I guess people were, we had other people
2 taking a less conservative stance.
3 MR. SHUMAKER: And I guess as a utility, you are
4 kind of in a position where you have to look at what, you
5 know, I don't want to say what your worse case is, but where
6 you could end up with these things, and that is where I
7 would end up with that.
8 Okay. As we talked earlier, -- I had the page,
9 sheet 8 -- the fundamental requirements are not
10 performance-based, and a number of the issues in there, we
11 would submit probably can't be performance-based, but there
12 are attributes in there that could be performance-based or
13 made more performance-based.
14 Some of the issues that we have --
15 DR. POWERS: What about the 250 foot fire hydrant
16 standard?
17 MR. SHUMAKER: I believe that could be more
18 performance-based.
19 DR. POWERS: Did you comply or not? That is the
20 thing.
21 MR. SHUMAKER: Well, we actually complied with
22 that standard. And for the most part, we complied with many
23 of the standards, or we had an alternate strategy that was
24 previously accepted by the NRC. And this basically comes to
25 what you just identified, and that is that our concern is

1 with the elements that weren't really required prior to 805,
2 that are not specifically addressed in our license, our
3 license is silent. We may have some alternate strategy.
4 For insurance purposes, we may have used some kind of a
5 strategy to protect that element, but because it wasn't an
6 NRC requirement, it hasn't been reviewed and approved.
7 And there is a couple of examples that I have
8 shown here. One is a requirement for interior finishes
9 which basically says that ceilings and walls need to meet
10 NFPA Class A requirements and floors need to meet Class 1
11 requirements, which are new requirements. There were
12 requirements for interior finishes in certain locations in
13 the branch technical positions, but in other cases it is not
14 delineated, so that would not be clearly delineated.
15 DR. POWERS: Is there potential for those
16 finishing requirements? I haven't looked at the standard.
17 It references another NFPA standard and I didn't look at it.
18 But is it likely to run into conflicts with ALARA principles
19 and radiation contamination control and things like that?
20 MR. SHUMAKER: I would suggest that most
21 decontaminant surfacers that we use probably don't
22 specifically comply with Class 1 codes.
23 DR. POWERS: Yeah, I would think not. Yeah.
24 MR. SHUMAKER: I actually was a coding engineer
25 when I started out my career, and I have had some experience

1 in that area.

2 In other areas, the requirement for plenum rated
3 cables above ceilings, our plant was designed with, you
4 know, 383 cable requirements. We have 383 cable throughout
5 the plant, including those plenum areas, and we do not
6 specifically use plenum rated cable in those areas.

7 Another requirement is for the Seismic Category 1,
8 Class 1, electric fire pumps. The one we talked about
9 earlier, just as another example that did not come out in
10 the pilot, is we do not have full barrier separation between
11 fire water pumps. We do have quite a bit of distance
12 separation. We also have an alternate set of fire pumps,
13 because Hope Creek and Salem's fire water systems are
14 inter-tied. So there we wouldn't specifically meet the
15 requirements. We would believe that we could get an
16 exception to that, but we don't, again, specifically meet
17 the prescriptive requirements of the standard.

18 Okay. With respect to fire models, the standard
19 requires you select an appropriate fire model and that you
20 look at both maximum expected and limiting fire scenarios.
21 At this point in time we have reviewed or are in the process
22 of reviewing three fire models. They are all zone fire
23 models, one is SEAFAST, one is MAGIC, and one is FIVE. And
24 we have plans to review COMPBURN, but consider that the
25 industry has had fairly significant experience with COMPBURN

1 when they did the IPEEEs.

2 Basically, the results, one of the things that is
3 interesting, and I don't know if it was clear when Bijan was
4 talking, but when you move to this, basically, a fire
5 becomes a new design basis. Once you go into this, any time
6 you create a new hazard, you have a design basis issue that
7 you need to establish or determine whether it has an impact
8 on your risk, at least that would be my understanding and
9 interpretation.

10 We looked at representative fire scenarios and
11 have identified that the simple zone models typically cover,
12 or are acceptable. The maximum expected fire scenarios, we
13 determined there was adequate guidance in the standard for
14 determining that. With respect to limiting fire scenarios
15 which are basically run to help us establish or identify
16 margin, we have run into cases where it is almost impossible
17 to get a fire big enough to cause damage.

18 And one of the other comments is that it is not
19 always, your damage isn't always based on fire size, it can
20 be based on other parameters as well. So it is not always
21 just a matter of seeing how big a fire you can make, but
22 looking at room geometries and the other sensitivities for
23 the area.

24 I will talk briefly about change analysis, it is
25 probably one of our more interesting areas. And one of the

1 things I suggest is that plants are dynamic, so, regardless
2 of whether you do this to go baseline or not, you are going
3 to be looking at changes against it once you establish it,
4 in the modifications and things that need to be reviewed
5 against it.
6 We did look at core damage frequency and also and
7 early radiological release. Basically, core damage
8 frequency was done kind of in a more quantitative type
9 method, although we didn't do full fire PSAs and things to
10 test these elements, and the LERF model was basically done
11 by qualitative analysis that we used to kind of understand
12 how we would go through a full LERF assessment and
13 understand what it takes and what the anticipated outcomes
14 would be.
15 DR. APOSTOLAKIS: What did you do in your IPEEE?
16 MR. SHUMAKER: You probably --
17 MR. NAJAFI: IPEEE, all it requires, there is no
18 LERF calculated in IPEEE.
19 DR. APOSTOLAKIS: How about CDF?
20 MR. NAJAFI: Oh, CDF, yes. Yes, CDF was
21 calculated.
22 MR. SHUMAKER: And keep in mind that the IPEEEs
23 are more of a vulnerability model.
24 DR. APOSTOLAKIS: Right. Did you do a FIVE
25 calculation?

1 MR. SHUMAKER: Well, we used some FIVE and it was
2 a modified FIVE. We did some FIVE for screening, but it
3 went beyond FIVE. And once we reached acceptable levels, we
4 quit. So the IPEEE model isn't a fire PSA model, per
5 Siemens, it is truly a vulnerability model.
6 DR. APOSTOLAKIS: So you don't have a CDF from
7 there? I mean a lot of these treated there can be used in
8 getting the CDF.
9 MR. SHUMAKER: Right. But I would submit that it
10 is not really a good plant model, you know, it is a
11 conservative vulnerability model.
12 MR. NAJAFI: But in following the general steps of
13 doing a fire PSA, it is no different than what is out there
14 in many cases. Like, for example, they have used screening
15 methods, FIVE and other approaches, to screen fire areas.
16 But once they get into this -- I mean unscreened areas,
17 let's say, there is a systematic way of defining fire
18 scenarios using a fire model to calculate the fire damage
19 timing of the detection actuation, all that kind of stuff.
20 But what I am trying to say, that it is really not
21 that different from how you do a fire PSA, because you still
22 do screening in a fire PSA. You don't establish fire
23 scenarios in every fire area of the plant, you do it in
24 important areas.
25 MR. SHUMAKER: Okay. I will go ahead and move on.

1 Some of the results of the change analysis, we had a lot of
2 very interesting discussions in some of these areas. The
3 first one had to do with determination of baseline risk, and
4 we kind of touched upon it with some earlier questions.
5 When we went to Appendix R, basically, there were
6 three different options under Section 3-G, and each of those
7 options provides a different baseline risk profile if you
8 review your plan under those. And then many plants, and
9 Salem is one of those plants, have exemptions. So you
10 basically end up with a compliance strategy that is kind of
11 a combination of one or a number of the Appendix R criteria,
12 along with some exemptions, in determination of baseline
13 risk.
14 The other thing to keep in mind is that, as a
15 function of time, changes have been and continue to be made
16 to the plant with respect to that baseline risk. Things
17 that can be changed within the prescriptive rules of
18 Appendix R, and within the compliance strategies, are
19 ongoing on a day-to-day basis, and there is even, you know,
20 would be a backlog of design changes that would actually be
21 part of that baseline risk. So we had a lot of discussion
22 as to where you draw the line in establishing your baseline
23 risk, and had significant discussion on that.
24 DR. APOSTOLAKIS: Where does the standard require
25 that you have a baseline risk?

1 MR. SHUMAKER: Well, I would suggest that if you
2 are going to create a fire PSA, you have got to know what
3 you are going to base it on. It has got to be based on a
4 plant configuration.
5 DR. APOSTOLAKIS: True.
6 MR. SHUMAKER: And that plant configuration can be
7 yesterday's, it can be today's. It can be something that
8 you actually, from a design perspective, have in the works,
9 design changes that may not be in the plant but have been --
10 DR. APOSTOLAKIS: I mean this is a rational view
11 of the world, Dennis. I am asking does this --
12 DR. POWERS: Irrational.
13 DR. APOSTOLAKIS: Does the standard itself say
14 somewhere that you should have a baseline risk?
15 MR. HENNEKE: I think what he is referring to is a
16 baseline risk for a fire zone.
17 MR. SHUMAKER: Right. Exactly.
18 MR. HENNEKE: Not for the plant. So if you are
19 looking for a zone that would meet deterministic, what is
20 the baseline risk, and delta CDF is the risk above that.
21 DR. APOSTOLAKIS: Deterministic? No, it can't be.
22 MR. NAJAFI: No, I think it is a little bit more
23 when -- even if you go through the process of change
24 analysis, which appears at the box, let's just for a minute
25 assume -- I know you question this -- that this standard,

1 one of its intended applications was to be used to evaluate,
2 examine changes to the plant licensing conditions.
3 DR. APOSTOLAKIS: For changes, I agree.
4 MR. NAJAFI: Changes. I mean this is what we went
5 through. For the change analysis, the issue is where you
6 assumed you started. For example, the plant was licensed
7 for certain areas of the plant, which may be two or three,
8 or ten areas of the plant, for a three-hour barrier here, a
9 one-hour and a manual suppression here. Now, five, 10 years
10 later, you are finding out that this three-hour is only
11 one-hour, and it has some combustible capability, and so
12 does this one.
13 Do you start as your baseline to be as the plant
14 was licensed or as the plant is today? Where would you
15 start? And then where would you want to come back? Do you
16 want to come back to where you were licensed to? Do you
17 want to come back as long as you can show acceptable risk?
18 Do you want to come back --
19 MR. SHUMAKER: He understands, I can tell.
20 DR. APOSTOLAKIS: Do you want to come back where
21 these guys think you are?
22 MR. SHUMAKER: Well, and you are absolutely
23 correct.
24 DR. APOSTOLAKIS: Otherwise, your license basis is
25 different from what they think it is.

1 MR. SHUMAKER: But keep in mind, we are allowed to
2 make -- you know, I may have a compliance strategy in a
3 room, and I may add a new hazard, and that will change the
4 risk profile for the room, but I have been allowed to make
5 that change under the 50.59 process and our fire protection
6 program. So, I have evaluated under our compliance
7 strategy.
8 DR. APOSTOLAKIS: But if it is 50.59, Dennis, it
9 shouldn't affect the baseline risk, should it?
10 MR. SHUMAKER: I would submit that it --
11 DR. APOSTOLAKIS: Say it. Say it. That it would.
12 Don't say it.
13 MR. SHUMAKER: It might not affect it. It might
14 not affect it at the top, but it might affect it down.
15 [Laughter.]
16 MR. SHUMAKER: It might reduce the risk. Sure, it
17 could reduce the risk.
18 DR. APOSTOLAKIS: Or reduce the risk.
19 MR. SHUMAKER: It could reduce the risk. And do I
20 want to use that new reduced risk as my baseline, or do I
21 want to use the higher risk from the original -- you know
22 where I am coming from, I think.
23 DR. APOSTOLAKIS: Let's not bring 50.59 in.
24 MR. SHUMAKER: Yeah, yeah, yeah. Okay. I
25 understand that.

1 MR. NAJAFI: Basically, the list that you --
2 DR. APOSTOLAKIS: I have no more questions.
3 MR. SHUMAKER: Okay.
4 DR. APOSTOLAKIS: I don't want any more answers.
5 MR. SHUMAKER: I am going to go ahead then.
6 DR. APOSTOLAKIS: I think we understand.
7 DR. POWERS: Are you continuing on this slide?
8 MR. SHUMAKER: I am going to continue on this
9 slide.
10 DR. POWERS: Please.
11 MR. SHUMAKER: The next issue is determination of
12 the risk acceptance criteria, and we talked about that
13 earlier as well, so I won't go into discussion on that.
14 The next issue is bundling, and that is bundling
15 in different aspects, you know. One is fire risk across
16 fire areas, and I will give you an example just for talking
17 purposes on how this works out. We talked about I have some
18 wrap in an area that doesn't quite make an hour, and I need
19 to upgrade it.
20 And I say, well, I have this package of money now
21 that I am going to go fix this wrap with. But I look in
22 another room and I say, but, boy, if I spend that money on
23 this room and put automatic fire suppression in, it has a
24 lot more significant impact on my plant risk. And, of
25 course, that is where I want to put that money is reducing

1 the risk.

2 So, you know, so bundling becomes an issue that I

3 think needs to be discussed and thought through.

4 DR. APOSTOLAKIS: There is some discussion in

5 1.174.

6 MR. NAJAFI: You know, a good example of that is

7 that in one side you don't want the people to just make a

8 change in one fire area and demonstrate acceptance in one

9 fire area, because you want to say, what is the impact on

10 the total plant risk? But on the other hand, if you put the

11 acceptance criteria on the total plant risk, then for every

12 problem, everybody will be fixing their control room.

13 MR. SHUMAKER: And, you know, you get into the

14 same type thing when you -- you know, fire risk versus total

15 risk, again, when you do make a change, you need to evaluate

16 -- I will give you an example. If I add, this is, you know,

17 maybe I add sprinklers in an area, and now I add new pipes,

18 and the pipes change my internal flooding hazard.

19 So you need to understand what the implication of

20 one area is one the other. And, again, you need to bundle

21 to understand your overall, you know, shift in risk for that

22 modification, not just how that affects the fire portion of

23 the equation.

24 And then the third one is --

25 MR. NAJAFI: One point to make about this list, we

1 made this list, as we went through this exercise, when
2 questions came up. It doesn't mean that we came up with
3 answers for every one of these. It means that these were
4 the ones. Some we had some answers, some we didn't.
5 DR. APOSTOLAKIS: We have realized that.
6 MR. NAJAFI: I mean I just told you.
7 DR. APOSTOLAKIS: I am sorry, it was a low blow.
8 You set it up so nicely.
9 DR. POWERS: The issue of bundling, it looks to me
10 like the standards just kind of copied the approach done in
11 1.174, is that correct?
12 MR. HENNEKE: Not exactly. We discussed bundling
13 in the Appendix A. It was an attempt at interpretation of
14 what 1.174 was talking about, and that was that you can
15 bundle changes as long as they affect the same scenario, or
16 same fire protection feature. But, unfortunately, with
17 regard to wrap that is in multiple areas, then the question
18 of what are you going to consider bundling, that is just
19 beyond -- we couldn't think of all of the possibilities, so
20 we knew the applications would come up with this.
21 So we tagged it on feature, but that doesn't mean
22 we can have the same feature in 50 rooms and then have some
23 sort of schematic for bundling figured out.
24 DR. POWERS: I mean it seems to me like bundling
25 is a really good idea.

1 MR. SHUMAKER: I think so, too. Absolutely. I
2 fully agree.
3 DR. POWERS: A good thing, and maybe at the cost
4 of degrading another thing, but the combined thing is a good
5 thing. Why should we ask that you analyze the bad thing in
6 isolation of the good thing that you have done? It just
7 makes no sense to me.
8 MR. NAJAFI: Yeah, even bundling sounds good. If
9 you do not bundle, you are going against the premise of
10 performance and risk. And it is telling you, deal with
11 where the problem is.
12 DR. POWERS: Yes.
13 MR. NAJAFI: But, as I said, it pushes everybody
14 to fix the control room every time there is a problem
15 anywhere in the plant. Do we want that always?
16 DR. APOSTOLAKIS: I think the original idea was
17 that you shouldn't propose two completely different plant
18 changes and one is negative, the other is positive, and the
19 net effect is positive. The staff would not like that.
20 I mean in this case, what Dennis said, you know,
21 with the flooding and so on, I mean they are very related,
22 so it makes sense. But to come in there and ask, you know,
23 to extend the outage, the allowed outage time for a piece of
24 equipment, and to do something, also propose something else
25 which is entirely different, which is very, you know,

1 positive and say, well, gee, you see.

2 MR. NAJAFI: The negative.

3 DR. APOSTOLAKIS: Yeah, that doesn't make sense.

4 DR. POWERS: I don't understand why it doesn't

5 make sense. I mean you analyze the plant as an integrated

6 whole. Why can't these guys make changes as an integrated

7 whole?

8 DR. APOSTOLAKIS: There are unspoken principles.

9 DR. POWERS: Oh, unspoken principles. Unspeakable

10 principles is what you are talking about.

11 MR. HENNEKE: I will give you an example. Our

12 plant --

13 DR. APOSTOLAKIS: We want a balanced design.

14 MR. HENNEKE: -- is making a change because it is

15 a good idea, and they are adding a little Honda generator to

16 run our steam generator level on a station blackout. So we

17 can see what the steam generator level is for an infinite

18 amount of time, and we can run our turbine-driven pump for

19 an infinite amount of time, so seismic and fire, and station

20 blackouts all are now reduced by a considerable amount, and

21 it is going to reduce our plant risk by over 50 percent.

22 That is a lot.

23 I mean we are a 7e to the minus 5 plant, and now

24 we are going to be a 3e to the minus 5 plant, so I have got

25 4e to the minus 5 to play with. Shouldn't I go bundle that

1 with something and, you know, --

2 DR. POWERS: I don't know that you would go out of

3 your way to find something to make bad. But if, in the

4 course of making something good, if you have something else

5 degrades, but the net effect is a good thing, I mean it

6 seems to me, if we are going to analyze these things as an

7 integrated whole, let's analyze them as an integrated whole.

8 We know what you are, George, we are just arguing about

9 price now.

10 MR. SIEBER: You can use this margin to offset the

11 fire risk caused by the Honda generator.

12 MR. NAJAFI: Well, that is the second one, fire

13 risk versus total risk.

14 DR. POWERS: For purposes of evaluating -- each

15 individual change shall be performed. I mean this is -- it

16 seems to me to be hanging on to the old style when we have

17 got new technology coming to us. I just -- I think you

18 ought to be able to bundle.

19 MR. SHUMAKER: Thanks, Dana. We appreciate that.

20 DR. POWERS: I know. But I think a dollar will

21 get you a cup of coffee at a cheap diner.

22 MR. SHUMAKER: I understand. Okay.

23 MR. SIEBER: Can we move on?

24 MR. SHUMAKER: Yes. The next one is recognizing

25 differences, and this is something, more of an observation,

1 the way we analyze Appendix R and the way we analyze the PSA
2 models. There are some differences, and I think they are
3 good differences, you know, but there is things we credit in
4 PSA space, we don't credit in Appendix R space, and it is
5 dealing with those in the fire PSA model.
6 Evaluation of spurious equipment actuations.
7 MR. NAJAFI: I think one fundamental difference is
8 that the Appendix R, the way it looks at the success and
9 crediting system at some areas is totally different than
10 traditional in PRA.
11 We talked to a large extent this morning about ADS
12 and LIPSI and low pressure systems. That is in the PSA but
13 it is not in the Appendix R. In many cases, even the
14 assumptions of Appendix R even goes against the PSA
15 assumptions, that one requires some safety system to start,
16 the other one requires some safety system to stop. Why?
17 Why? I mean it does happen.
18 DR. APOSTOLAKIS: It does happen.
19 MR. NAJAFI: It does happen. The approach we took
20 -- and the other one is that one goes to 72 hours and to a
21 different stop mode, and one goes to 24 hours and a
22 different stop mode.
23 Basically, this comes more into the play of a
24 conflict when you have a prescriptive requirement mixed with
25 your performance of the risk requirement, because your

1 prescriptive requirement says that you have got to accept
2 the R, Appendix R's definition of a success. Your risk says
3 you can accept the PRA definition of success and state
4 two-thirds of the below active fuel to some extent.
5 And the way we left it at the pilot at this point,
6 we did not try to reconcile the two differences, to leave
7 them at the level they are. The PRA measures the risk that
8 can be superimposed if the two of them have to be used in
9 conjunction. But that is the conceptual -- there are
10 substantial, at times, differences.
11 DR. APOSTOLAKIS: When are the reports coming out
12 of this?
13 MR. NAJAFI: The end of the year.
14 MR. SHUMAKER: The end of the year.
15 MR. NAJAFI: It is supposed to be November 10th.
16 DR. APOSTOLAKIS: The end of the year, not in a
17 year.
18 MR. SHUMAKER: End of the year, this year.
19 SPEAKER: November 10th, and apparently it is a
20 couple of weeks behind.
21 DR. APOSTOLAKIS: Okay.
22 MR. SHUMAKER: Okay. Evaluation of spurious
23 equipment actuations, I think we have chatted about that, so
24 we will move on. And quality and maintenance of the PSA,
25 that has also been discussed and so we will move on to the

1 next one.

2 Other modes of operation. This is a new

3 requirement and something that we haven't really looked at a

4 lot.

5 Go to the next sheet, please.

6 DR. APOSTOLAKIS: So the November 10th report will

7 not have the other modes?

8 MR. SHUMAKER: Other modes will be discussed in

9 there, right?

10 MR. NAJAFI: It will be discussed, but I want to

11 clarify that the other modes does not mean that it is going

12 to be a shutdown fire PSA.

13 DR. POWERS: Oh, come on guys, you have got till

14 the 10th.

15 MR. SHUMAKER: We are scheduled to complete that I

16 think the second quarter of next year.

17 DR. APOSTOLAKIS: So the pilot continues.

18 MR. SHUMAKER: Well, it has actually, it has gone

19 beyond a pilot, we have started a project to do a fire PSA

20 for Salem.

21 MR. NAJAFI: The objective of the pilot, I call

22 it, was proof of principle. We did not go in many areas if

23 we consider it not necessary to the depth, and it may be to

24 this level, only places that it was necessary. Like a good

25 example is we did more detail in Chapter 3 because we really

1 felt that that could be, I mean, a prohibitive part of
2 adopting the entire standard as a licensing basis. So we
3 did more in that.
4 DR. APOSTOLAKIS: Okay.
5 MR. SHUMAKER: So, as a result of review of other
6 modes of operation, we propose a revision to the inventory
7 control criteria in 805, and I believe that still stands as
8 change. And that was more a result of our doing a review,
9 not because it had any real impact on Salem's ability to
10 meet other modes of operation criteria.
11 We also identified about 40 new components that we
12 added to our analysis. They are basically instrumentation
13 for reactor instrumentation, some spent fuel pool cooling.
14 So there are things like that and we also
15 identified a need to revise their outage management
16 procedures to address other modes of operation within 805.
17 DR. APOSTOLAKIS: Let me understand that.
18 You identified the need to revise the outage
19 management procedures.
20 MR. SHUMAKER: Yes. What basically -- go ahead.
21 DR. APOSTOLAKIS: I thought those things were
22 managed adequately. Isn't that what we were told?
23 DR. POWERS: Repeatedly.
24 DR. APOSTOLAKIS: So the industry now comes back
25 and says that you have to revise them because you did PSA?

1 MR. SHUMAKER: Well, I think what it basically is
2 saying is that we have looked at our outage management
3 procedures and during -- for instance if we do a core
4 offload we want to provide different or additional
5 protections, provide additional protection to how we guard
6 spent fuel pool cooling.
7 Now we do have as a plant alternate strategies for
8 that that would not require one of our spent fuel pool
9 cooling trains but we don't want to rely on that so we would
10 in fact revise our outage management strategy to protect one
11 of the two trains.
12 MR. NAJAFI: I don't know if this is related.
13 DR. APOSTOLAKIS: It's all related.
14 MR. NAJAFI: If this is what you are asking but --
15 MR. SHUMAKER: Keep going.
16 DR. APOSTOLAKIS: This was in a different context.
17 MR. SHUMAKER: Okay. Next we will go to
18 radioactive release and basically the NFPA 805 standard
19 requires that a radiation release due to fire that is not
20 from fuel damage or from damage to tanks and the like be as
21 low as reasonably achievable but not exceed 2 millirems per
22 hour, and through the review we identified that that 2
23 millirems per hour came out of Part 20. It was a part of
24 Part 20 and we recommended a change or proposed revision to
25 make Part 20 the criteria for that.

1 We also proposed a revision to add guidance to an
2 appendix because there was not, we didn't believe there was
3 adequate guidance within the standard to do radioactive
4 release and that has been moved to the implementation guide.
5 The intent is to put that in the implementation guide.
6 When you say nonfuel, what do you mean?
7 MR. SHUMAKER: Well, LERF is really when you get
8 fuel damage. This would be a fire that causes a radwaste
9 system to --
10 MR. SIEBER: It causes a spill or something.
11 MR. SHUMAKER: Right, damage to a radwaste system
12 or a valve opens and re-releases gas or something like that,
13 you know.
14 DR. APOSTOLAKIS: So where is the spent fuel pool?
15 Covered?
16 MR. SIEBER: It is not covered by the fire.
17 MR. SHUMAKER: Yes. I am not sure how that fits
18 into radioactive release.
19 MR. SINGH: It is covered under radioactive
20 release.
21 MR. SHUMAKER: But I don't know how it was --
22 DR. APOSTOLAKIS: Under this?
23 MR. SHUMAKER: Under this.
24 MR. SINGH: Spent fuel pool I think.
25 DR. APOSTOLAKIS: So if I want to do any changes

1 there what do I do? Do I do a risk assessment or Regulatory
2 Guide 1.174 applies to that? I don't remember -- or is it
3 just for the reactor?
4 If you want to implement the changes, the bottom
5 part of the figure we discussed earlier, do that for the
6 spent fuel pool, what would you do?
7 MR. NAJAFI: It goes through basically this whole
8 box and you at the end go through the change analysis.
9 DR. APOSTOLAKIS: Yes, but I mean if 1.174 does
10 not apply I don't know what to do. Does it apply?
11 MR. NAJAFI: 1.174 --
12 DR. APOSTOLAKIS: You don't have a CDF?
13 MR. NAJAFI: I don't believe it applies. It only
14 applies to CDF and LERF, but what I am saying is that in 805
15 one of your performance criteria that are established in
16 here -- identify performance criteria -- if there's changes
17 to it goes through this risk -- change evaluation process.
18 DR. APOSTOLAKIS: So I would have some sort of a
19 probability distribution of possible releases from the spent
20 fuel pool and then I would have a baseline and a change --
21 MR. NAJAFI: Right, some estimate of change in
22 risk.
23 MR. SHUMAKER: And if you made a change you would
24 have to reassess how that change --
25 MR. NAJAFI: It's an estimate of change in risk.

1 DR. APOSTOLAKIS: And since the Staff has not
2 given us the equivalent of a Regulatory Guide 1.174 we would
3 be in deep trouble.
4 MR. NAJAFI: We don't have the equivalent of 1.174
5 partitioned to Fire, E.
6 DR. APOSTOLAKIS: No, but at least I can claim --
7 [Laughter.]
8 DR. APOSTOLAKIS: -- CDF.
9 MR. SHUMAKER: So I would suggest that you could
10 put stuff like that in the implementation guide.
11 DR. APOSTOLAKIS: That is pretty significant.
12 MR. SHUMAKER: Okay. We acknowledge the lack of
13 guidance there and the thought was that the guidance could
14 be provided in the implementation guide so that is the
15 present strategy I believe at this time of those type of
16 issues with this section. Okay? Can I move on?
17 MR. SIEBER: Okay.
18 MR. SHUMAKER: Great. Thanks. 17, please.
19 Talk about the programmatic aspects, which is a
20 fairly simple 805 requires program to monitor, document and
21 maintain configuration control and quality control
22 oversight.
23 Next slide, please. Of course, programmatic
24 control isn't new to us. We have maintained programs in
25 documentation and things from day one with the exception of

1 the IPEEE's, which were kind of a shot in time, so basically
2 the attributes are presently addressed. If we went to this
3 we would end up creating a fire PSA model that would require
4 control just like any other document that we would have and
5 we would need to update some of our design drawings to
6 identify the items that we have credited in that PSA and I
7 will suggest for instance that the IPEEE took credit for
8 components that are not necessarily design components and we
9 would need to update the drawings to identify or establish
10 that those were -- would be design components.
11 There would be some training anticipated and the
12 components that were credited would need to be included in
13 the monitoring program, so those would be the results of
14 that.
15 In conclusion, is it complete? Our answer is yes
16 and that is provided that we get a reasonable implementation
17 guide. Like I say, there are attributes that we had, some
18 missing guidance and we need to get that covered.
19 Is it practical? And again, yes, we believe it is
20 practical, but there are implementation guide issues.
21 Cost effective -- issues related to fundamental
22 requirements and also the PSA quality could impact cost
23 effectiveness. We believe this could be a cost effective
24 standard but it is all on how things play out here.
25 Usable in whole or in part? We believe it is

usable as an alternate licensing basis and it also provides a reasonable strategy for reviewing exemptions, deviations and other modifications.

That is how I will conclude my discussion.

MR. SIEBER: Thank you very much.

MR. SHUMAKER: Thank you.

MR. SIEBER: Any further comments or questions from the members?

DR. APOSTOLAKIS: Are you coming back in November?

MR. SINGH: Yes.

DR. APOSTOLAKIS: How much time do they have?

MR. SINGH: Well, we have allowed two hours but I cannot ask for more time.

MR. SIEBER: I think they are going to need to.

DR. APOSTOLAKIS: If you can address this issue that we had a discussion on earlier, acceptance criteria and the consistency between the deterministic and performance-based approaches, and the relationship to the criteria above, that would be very helpful to me. There isn't much time until the November meeting but I mean you could come up with some thoughts.

MR. NAJAFI: What is this November? Is it the NFPA meeting or something?

DR. APOSTOLAKIS: No, here, the ACRS.

MR. SIEBER: The ACRS full committee.

1 MR. SHUMAKER: Is that before the November 15th?
2 DR. APOSTOLAKIS: Yes, it is the first week,
3 right?
4 MR. SINGH: Your question, George, would you
5 repeat that so I will make sure --
6 DR. APOSTOLAKIS: Well, we had a full discussion
7 earlier about "Go to Figure 2-2" -- that, you know, if I go
8 the deterministic way I have to take certain things on
9 faith. If I go the performance based I don't have
10 information because I end up with probabilistic numbers. I
11 think Bijan understands what the issue is.
12 MR. SINGH: But he might not be here next week.
13 DR. APOSTOLAKIS: But he understands.
14 [Laughter.]
15 MR. SIEBER: That may be why he isn't there.
16 DR. POWERS: It's just a continuation of a war you
17 have been fighting on deterministic analysis for some
18 time -- a rehashing of something we have all heard ad
19 nauseam.
20 MR. SIEBER: Yes, perhaps we ought not burden the
21 committee with that.
22 DR. POWERS: I don't think we ought to ask him to
23 resolve an issue we can't resolve.
24 DR. APOSTOLAKIS: This is very serious.
25 MR. SIEBER: Any further questions?

1 DR. POWERS: Well, let me ask this question. If
2 we adopt this standard are we getting out of the woods?
3 I mean up till now one of the big challenges we
4 have had in the area of inspection on plants for fire
5 protection is we have had Appendix R, BTP plants and even a
6 third category that escapes me right now.
7 MR. SINGH: Licensing condition plants.
8 DR. POWERS: Yes, thank you, Jit.
9 Now we are going to have Appendix R plants, BTP
10 plants, licensing condition plants, 805 deterministic
11 plants, 805 performance plants.
12 Is this getting us out of the woods?
13 MR. SIEBER: I think we are going deeper into the
14 woods. The trick for the licensing person is to keep track
15 of on what basis each of these categories --
16 DR. POWERS: Well, you see how facile that keeping
17 track is by the functional fire inspection where guys are
18 spending a million dollars to reconstitute their design
19 basis for fire protection.
20 I mean this just gets to be a bigger nightmare all
21 the time.
22 MR. SIEBER: Yes, I agree.
23 DR. POWERS: And I think you ought to be able to
24 bundle.
25 [Laughter.]

1 MR. SIEBER: I would remind all present that
2 tomorrow's continuation of this meeting will be next door in
3 Room 2-B1 --
4 DR. APOSTOLAKIS: Just because I am leaving?
5 MR. SIEBER: Yes -- where we don't need as much
6 room anymore.
7 [Laughter.]
8 MR. SIEBER: And the ACNW will meet here, so those
9 of you who are coming back for tomorrow's part of the
10 meeting, you can go next door.
11 We will start tomorrow at 8:30 and I would like to
12 thank everyone here who has given presentations. You have
13 done a good job. We reasonably kept to our schedule and we
14 appreciate the information, so thank you very much.
15 With that, I will recess until tomorrow at 8:30.
16 [Whereupon, at 6:15 p.m., the hearing was
17 recessed, to reconvene at 8:30 a.m., Tuesday, October 17,
18 2000.]
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REPORTER'S CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

NAME OF PROCEEDING: ACRS MEETING - FIRE PROTECTION

CASE NUMBER:

PLACE OF PROCEEDING: 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.

Mark Mahoney

Mark Mahoney

Official Reporter

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