

NUCLEAR REGULATORY COMMISSION

ORIGINAL

Title: Advisory Committee on Reactor Safeguards
506th Meeting

PROCESS USING ADAMS
TEMPLATE: ACRS/ACNW-005

Docket Number: (not applicable)

Location: Rockville, Maryland

Date: Thursday, October 2, 2003

Work Order No.: NRC-1102

Pages 1-126

NEAL R. GROSS AND CO., INC.
Court Reporters and Transcribers
1323 Rhode Island Avenue, N.W.
Washington, D.C. 20005
(202) 234-4433

TROY

**ACRS OFFICE COPY
RETAIN FOR THE LIFE OF THE COMMITTEE**

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

+ + + + +

ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS)

506th MEETING

+ + + + +

THURSDAY,

OCTOBER 2, 2003

+ + + + +

ROCKVILLE, MARYLAND

The committee met at the Nuclear
Regulatory Commission, Two White Flint North,
Room T2B3, 11545 Rockville Pike, at 12:30 p.m.,
Mario V. Bonaca, Chairman, presiding.

COMMITTEE MEMBERS:

MARIO V. BONACA, Chairman

GRAHAM B. WALLIS, Vice Chairman

F. PETER FORD, Member

THOMAS S. KRESS, Member

GRAHAM M. LEITCH, Member

DANA A. POWERS, Member

VICTOR H. RANSOM, Member

STEPHEN L. ROSEN, Member

WILLIAM J. SHACK, Member

JOHN D. SIEBER, Member

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 ACRS STAFF PRESENT:

2 SHER BAHADUR, Associate Director, ACRS/ACNW

3 RALPH CARUSO, ACRS Staff

4 I. JERRY DOZIER, Reactor Safety Engineer

5 SAM DURAISWAMY, Technical Assistant, ACRS/ACNW

6 MEDHAT EL-ZEFTAWY, ACRS Staff

7 JOHN FLACK, NRC Staff

8 CORNELIUS HOLDEN, NRC Staff

9 HOWARD J. LARSON, Special Assistant, ACRS/ACNW

10 HOSSEIN P. NOURBAKSH, ACRS Senior Fellow

11 WILLIAM S. RAUGHLEY, Senior Electrical Engineer

12

13

14

15

16

17

18

19

20

21

22

23

24

25

I-N-D-E-X

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

<u>AGENDA ITEM</u>	<u>PAGE</u>
Review of the PIRT Process	10
Operating Experience Assessment Report - Effects of Grid Events	58

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

(12:33 p.m.)

1
2
3 CHAIRMAN BONACA: Let's get started and
4 wrap up this briefing on fire issues.

5 MEMBER ROSEN: Are we on the record or
6 not?

7 CHAIRMAN BONACA: Yes.

8 MEMBER ROSEN: Okay. Now, you asked me to
9 go back, Mr. Chairman, and talk again about the fire
10 dynamics tools.

11 CHAIRMAN BONACA: Not just a complete --
12 I mean, I thought that --

13 MEMBER ROSEN: Okay. No, I was on the
14 fourth issue, which is the --

15 CHAIRMAN BONACA: All right.

16 MEMBER ROSEN: -- which is post-fire
17 operator manual actions.

18 CHAIRMAN BONACA: Okay.

19 MEMBER SHACK: I mean, we can get those on
20 a CD, right?

21 MEMBER ROSEN: Yes.

22 CHAIRMAN BONACA: So go to the fourth --

23 MEMBER ROSEN: They're on a website,
24 actually.

25 CHAIRMAN BONACA: Okay.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MEMBER SHACK: I can get the programs on
2 a website?

3 MEMBER ROSEN: I think they said that it
4 was on a website, but what I got was -- Mark Sally
5 gave me the book, a three-ring binder, and a CD-ROM.
6 Probably the easy way is to just ask him -- ask the
7 staff to have Mark Sally get a copy for you.

8 CHAIRMAN BONACA: Okay. So --

9 MEMBER ROSEN: Okay. So, then, the fourth
10 issue -- let me just recap. We've talked about
11 10 CFR 50.48, which is the rulemaking to allow
12 licensees to voluntarily adopt NFPA 805. We've talked
13 about post-fire safe shutdown associated circuits
14 analysis and the resolution of the issues there.
15 We've talked about these fire dynamics tools. And the
16 last issue that came up at the subcommittee was a
17 discussion of post-fire operator manual actions.

18 Now, there's a rulemaking underway on this
19 specific subject to address what has been found out to
20 be widespread reliance in safe shutdown analyses on
21 manual actions by operating staffs, in lieu of
22 physical barriers and equipment, which is what
23 Appendix R would proscribe.

24 Now, current requirements don't
25 specifically prohibit manual actions, but criteria for

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 when such actions can be relied on are needed. We've
2 talked about it in the subcommittee as feasible manual
3 actions. George had a problem with the word
4 "feasible." "Anything is feasible," said he.

5 But what was really meant was, can the
6 operators, in the time allotted, get to the equipment
7 without having to expose themselves to the effects of
8 the fire, smoke, heat, or radiation, and can do it in
9 a way that's in a procedure perhaps and not something
10 they have to invent or be heroic in order to carry out
11 the action.

12 Now, you should understand that that
13 rulemaking to allow reliance on feasible manual
14 actions has -- the NEI has petitioned the Commission
15 to simply codify the allowance for feasible manual
16 actions through the direct final rule process. In
17 other words, don't even bother to go through all of
18 the hoops. They want it now, and they want it quick,
19 and that's still on the Commission's table I guess
20 someplace.

21 Members of the subcommittee listened to
22 the presentations on this subject, and basically
23 suggested that the industry and maybe the NRC staff
24 working together should develop a quantitative
25 technique for evaluating manual actions that

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 incorporates human error forcing functions into it --,
2 in other words, uses the kind of human error models
3 that we have, which deals with error forcing functions
4 and established threshold values for evaluating the
5 risk effectiveness and acceptability of manual
6 actions.

7 In other words, take this manual action
8 that's relied upon by a plant, say, and set some --
9 how likely is it that the guy will be able to carry
10 out that manual action effectively, using the things
11 that are in the handbook on human error reliability
12 prediction.

13 That's not -- this isn't new. There's a
14 handbook out by Gutland & Swain that's been there a
15 long time, or some other technique that may be equally
16 valid. And so there wasn't any conceptual difficulty
17 with accepting the idea that one could take reliance
18 on human manual actions in fires if they were properly
19 analyzed.

20 And those were the four issues. As I
21 said, we'll have another subcommittee meeting in
22 February, and I think -- and then a full committee
23 meeting after that, just because we have to give the
24 Commission the benefit of our views on the 50.48
25 rulemaking.

1 MR. DURAI SWAMY: So we plan to write the
2 report at that time?

3 MEMBER ROSEN: At that time, yes.

4 MR. DURAI SWAMY: What do you think the
5 timeframe will be approximately for the full committee
6 meeting?

7 MEMBER ROSEN: February.

8 MR. DURAI SWAMY: February.

9 MEMBER ROSEN: Okay.

10 MR. DURAI SWAMY: Well, Steve, I think
11 50.48, we can look at the thing in the
12 November/December timeframe, the draft final rule.

13 MEMBER ROSEN: Yes.

14 MR. DURAI SWAMY: That's coming to the full
15 committee.

16 MEMBER ROSEN: Do you think it will come
17 that early?

18 MR. DURAI SWAMY: Yes, sir. They want to
19 come and to talk to us in our November meeting. And
20 if they can't give us the document, it'll be at least
21 December. So either November or December, we'll have
22 red letter on the draft final rule on 10 CFR 50.48
23 during --

24 MEMBER ROSEN: Now you're getting me
25 confused, Sam. But the direct final rule is not part

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 of 50.48.

2 MR. DURAISWAMY: What?

3 MEMBER ROSEN: The direct final rule is --

4 MR. DURAISWAMY: Oh, no, no. I'm not
5 talking about direct. The draft final rule on
6 10 CFR 50.48 to endorse NFPA 805.

7 MEMBER ROSEN: Okay.

8 MR. DURAISWAMY: So that rule we had red
9 letter.

10 MEMBER ROSEN: Yes, I understand, and
11 that's what I'm talking about.

12 MR. DURAISWAMY: Yes.

13 MEMBER ROSEN: That I think will be in
14 February.

15 MR. DURAISWAMY: No.

16 MEMBER ROSEN: You're saying it could be
17 earlier than that.

18 MR. DURAISWAMY: They just said they
19 wanted to come and talk to us in the November meeting
20 or December.

21 CHAIRMAN BONACA: November or December.

22 MR. DURAISWAMY: Yes.

23 MEMBER ROSEN: They'll have to work with
24 you and me, but I think that's -- that's early, but I
25 -- you know, I don't have any -- I'm not against it,

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 if they can get here that soon. I just assumed that
2 it would be next year, early next year, before they
3 could do it.

4 CHAIRMAN BONACA: Okay. Thank you very
5 much for the presentation.

6 And now we have a presentation by Dr.
7 Nourbakhsh on the PIRT process. We had postponed this
8 before, and so we are looking forward to it now. Go
9 ahead.

10 DR. NOURBAKHSB: Now I want to give you a
11 brief review of the PIRT process, and based on my
12 review of the limitations with it and how we can
13 enhance the process.

14 MEMBER ROSEN: Would you do that also in
15 the context of what we just heard about proactive
16 materials degradation?

17 DR. NOURBAKHSB: I will try to touch on
18 it.

19 As you know, PIRT stands for -- or was
20 initially a step in CSAU methodology, code scaling
21 applicability and uncertainty valuation methodology.
22 CSAU developed as a -- in order to support the revised
23 ECCS rule which was issued in September 1988. The
24 purpose of CSAU methodology/valuation methodology was
25 to demonstrate the feasibility of using best estimate

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 plus uncertainty approach.

2 So one step of CSAU methodology was
3 tabulating all of the important phenomena because they
4 wanted to focus on the parameters and phenomena which
5 impact the peak cladding temperature when they wanted
6 to do uncertainty, and at the same time for assessment
7 of experimental programs.

8 So, by the way, I looked at the PIRT in
9 the -- in order to review it, I just did a station
10 PIRT, and I found out that most useful PIRT was in
11 England, but it even stands for -- it stood for Police
12 Initial Recruiting Test.

13 (Laughter.)

14 And the least -- actually, I found
15 hundreds of PIRTs, and the least common was a meeting
16 on PIRT, again last year in England, on physical
17 interpretation of relativity theory. So there was a
18 wide spectrum of PIRTs.

19 MEMBER ROSEN: Well, we want to hear about
20 that.

21 DR. NOURBAKSH: Right. So anyway, what
22 PIRT process, since the initial development of CSAU
23 methodology, has been used in much more applications
24 than it was envisioned for. If you go back to the
25 background of CSAU methodology, that was a well-

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 understood phenomenon, relatively. A lot of
2 experience in that, a lot of tests, so there was not
3 really -- the knowledge base was quite a lot.

4 So the only reason for the PIRT in the
5 context of CSAU was just to tabulate systematically
6 all of the phenomena for completeness. It was a
7 brilliant idea to have a systematic approach to
8 identifying the phenomena.

9 But as we know, in your widespread use of
10 PIRT -- and Research is planning actually using PIRT
11 in prioritizing the research needs for advanced
12 reactor technical issues. I thought this is a good
13 time to look at the past and what we have learned from
14 all of these PIRTs. And by the way, they are very --
15 I mean, they are costly and resource -- I mean, they
16 are resource-intensive.

17 And to look at past several years of
18 experience with the PIRT --

19 MEMBER POWERS: That is one of the
20 comments I have gotten from the NRC project monitors
21 all the time. These PIRTs are incredibly expensive.
22 And when you think about it, you know, some of the
23 fuel supports, they had six meetings with 30 people
24 maybe, maybe less, and we're not talking about like on
25 the order of an FTE.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 DR. NOURBAKHS: On the order of one FTE?

2 MEMBER POWERS: Yes.

3 DR. NOURBAKHS: I have been quoted two
4 FTE or three FTE.

5 MEMBER POWERS: I won't argue with you on
6 those. One FTE --

7 DR. NOURBAKHS: It was one or two, yes,
8 but one --

9 MEMBER POWERS: And the test runs -- an
10 INPILE test nowadays runs a million bucks. Turn the
11 reactor on; it costs you a million dollars?

12 DR. NOURBAKHS: Yes.

13 MEMBER POWERS: Don't do anything with it.
14 That just turns it on, shuts it back down.

15 DR. NOURBAKHS: That's right.

16 MEMBER POWERS: I mean, that's just what
17 it costs to get the facility to turn it on and turn it
18 off for you is a million bucks, right? So now, is it
19 really all that expensive?

20 DR. NOURBAKHS: We are not -- the issue
21 is not expensive, but do we get what we have spent
22 for? I mean, if we enhance the process, the product
23 would be much more useful and much more transparent.

24 MEMBER POWERS: But you start saying, "I
25 will agree with you" right up front, that if I spend

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 any amount of money and don't get what I'm after
2 that's expensive. Okay? But to start in and say,
3 "Hey, this PIRT process is really expensive," I don't
4 think it's so expensive.

5 I think it's actually a money-saving
6 operation. It sure as hell saved the people in the
7 high burnup fuels more than it cost them, because
8 otherwise they -- I mean, it is a gold-plated defense.
9 If somebody comes in and says, "Well, you guys haven't
10 done X in your program," and you say, "We got a panel
11 of world-renowned experts together. They looked at
12 it, and they told us not to do X."

13 You've just saved yourself an enormous
14 amount of effort right there. That's worth an FTE
15 right there. ACRS sits there and says, "You guys
16 haven't done X." You've got a perfect defense, and we
17 can't say a damn thing about it. It shuts us -- it
18 shuts Peter up.

19 MEMBER ROSEN: It doesn't shut you up. I
20 know that nothing --

21 MEMBER FORD: I just grumble all the time,
22 so they don't pay any attention to me.

23 (Laughter.)

24 DR. NOURBAKSH: All right. Okay. The
25 objective in here is to review the PIRT process and

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 product application and to provide some suggestions
2 for enhancement of the process, basically.

3 An overview of the PIRT process basically
4 is multi-step. You define what the problem is, what
5 the technical issue is, what are the objectives for
6 this PIRT, whether you are doing it for code
7 development or assessment, or you are doing it for
8 uncertainty evaluation of the code, or some
9 development of some experimental program.

10 Basically, then you define your system,
11 what are you looking at? Is that in the vessel, or
12 you are looking at spent fuel pool, or basically the
13 third step would be to define the hardware. And then
14 you define the scenario. Basically, what are the
15 boundary conditions for these technical issues? And
16 if it is accident analysis, basically the definition
17 of the sequence.

18 And then, what are you looking for? What
19 would be -- you are doing it. What would be the
20 figure of merit or definition, evaluation criteria?
21 You are looking for peak cladding temperature, or for
22 PTS we are looking for pressure temperature gradient,
23 temperature basically.

24 And then, you identify and obtain and
25 review the database which is available on the subject

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 matter. And then, you come to a -- the meeting. You
2 start with the brainstorming to put all these
3 plausible phenomena on the table. The phenomena, by
4 definition of PIRT, is not -- it could be a process.
5 It could be a variable. It could be anything which
6 may impact the figure of merit or evaluation criteria.

7 And there is some dependency between all
8 of these parameters, too, but they are not really
9 transparent in -- on those tables. For example, they
10 said on AP600 subcooling margin and boiling and
11 flashing. They are -- basically, your interest in
12 subcooling margin is really important, because it
13 impacts flashing or all of these parameters or things
14 like that.

15 And then, the last step would be you rank
16 the importance of these phenomena, have done in
17 different levels, could be done highly important,
18 which has a dominant effect on the figure of merit, or
19 low importance or medium. Or you can give a numerical
20 scale one to five, one to seven. And in some cases --
21 I come back to it -- they use the Sally AHP process to
22 prioritize these. I mean, pair-wise ranking which
23 also has been used to rank all of these phenomena.
24 And then, you document the results.

25 So it's not really the process per se has

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 not been documented. I mean, it was an evolving
2 process. It was one step in CSAU methodology, and you
3 don't see the definition of the process or a manual
4 for the process or -- except a paper in Nuclear
5 Engineering Design some years back.

6 So my observation so far in reviewing more
7 than 20 of them was success in developing PIRT is a
8 strong function of the degree to which supplemental
9 information are well documented. There are various
10 degrees that you could see, but sometimes those
11 implicit assumptions that experts made is not
12 transparent in those presentations. You have to go to
13 appendices, or they were somewhere.

14 Really, if you wanted to revise a PIRT,
15 you need to do a lot to understand why it was
16 important or why there was a difference of opinion,
17 basically.

18 So this shortcoming may be partly due to
19 lack of a systematic methodology to capture these --
20 all of these implicit assumptions that the expert
21 made. And the way these -- of course, the product is
22 not only the tables, it is the supplemental
23 documentation. But that supplemental documentation is
24 not really -- in some of them -- I am not generalizing
25 it -- are well documented.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 Sometimes the individual panel members may
2 be expert in some phenomena. In thermal hydraulics,
3 we don't have that problem, because most of these
4 thermal hydraulic issues everybody is familiar with
5 that. When you go to an area which is multi-
6 disciplinary, the chemistry aspect is important,
7 thermal hydraulics, neutronics.

8 Then, look at burnup credit program. It
9 has -- some panel members may be expert in some
10 phenomena and less familiar with other phenomena. So
11 in order to deal with this reality, they were asked
12 not to vote on the issues that they are not familiar
13 with. But all of these phenomena when you look at
14 them, they are interconnected. They are a network.

15 When you are saying -- you are asking the
16 bottom-line question, importance of this to my figure
17 of merits, he has to implicitly make some judgments on
18 some other phenomena which he may not be familiar with
19 to come up with to do that ranking. So that is -- I
20 am not sure that this always could be done.

21 MEMBER ROSEN: Now, before you leave this
22 subject, because I think it's very important relative
23 to the proactive materials degradation PIRT, I mean,
24 there you're going to have a lot of experts. But the
25 field is so robust and broad and important that the --

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 there will be chemistry experts and materials experts.
2 But even the materials experts will be expert in one
3 aspect of materials and not others.

4 DR. NOURBAKSH: Or some mechanical
5 aspect.

6 In some prior PIRT efforts, again, there
7 are major observation limitations. Pair-wise
8 importance ranking of components for phenomena -- this
9 AHP analogy called hierarchy process. Basically, you
10 go top-down linear to -- you look at your component or
11 the time phase component and under each component's
12 phenomena. And then you rank them, and then there is
13 an algorithm based on ranking value of matrix that
14 they form.

15 They come up -- the idea behind this AHP
16 is that the people are much -- when you have 20 issues
17 in front of you to rank, it's very difficult. But
18 when you compare them pair-wise one by one of each,
19 it's much easier. So you get the input of the expert
20 pair-wise two at each time -- all of the permutations.

21 And then, you come up at the end with an
22 idea of to --

23 MEMBER POWERS: But it doesn't work.

24 DR. NOURBAKSH: -- come up with the
25 bottom line.

1 MEMBER POWERS: It doesn't work. I mean,
2 the whole history of marketing is replete with people
3 doing pair-wise ranking and finding A is better than
4 B, and B is better than C, and C is better than A. I
5 mean, it is replete with that. It fundamentally has
6 that flaw and it, and it -- any time you're looking at
7 multi-attributes you run into this problem.

8 DR. NOURBAKSH: Actually, Sally himself
9 recognized that, the man who developed AHP, and later
10 on actually criticized in his recent book AHP, and he
11 came up with something which is called ANP, analytical
12 network IIT, that's looking at all of these
13 interactions because the real practical problems are
14 not linear top-bottom, especially the nuclear safety
15 issues.

16 We have feedback effects. We have
17 interaction with all of these phenomena and systems
18 that you cannot just ignore them and then --

19 MEMBER POWERS: It seems to me that --

20 DR. NOURBAKSH: -- trying to --

21 MEMBER POWERS: Well, it seems to me that
22 the thermal hydraulics guys, when they implemented
23 PIRT, did it right. And they said, "Look, formulate
24 some simple models and show me quantitatively how
25 things work, or where the time scales are," some way

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 to do this in an analytic representation rather than
2 relying strictly on opinion.

3 And they had some advantages in doing
4 that, but I think that when it's -- when that kernel
5 of an idea from the thermal hydraulics people was
6 taken and applied that the part they threw out was
7 that part. That may be incorrect. Show me how
8 important these things are.

9 For instance, I mean, I made my attack on
10 some of the recent PIRT activities yesterday. We
11 wrote a diffusion equation for transport through
12 coated particle fuels. And that's a lot like these
13 thermal hydraulic equations you guys get to work with,
14 has a lot of terms in it, has terms due to chemical
15 diffusion, pressure-driven diffusion, temperature-
16 driven diffusion.

17 And I said, "Okay. Well, you've got all
18 of these things that are important," and they let me
19 get away scot-free with that. And nobody -- nobody at
20 any time asked me, you know, what's the relative
21 importance of these terms? If they had, you know, I
22 would have had to admit that, hey, the only one that
23 matters is the DMCO-driven pressure through the
24 silicon carbide layer.

25 But they didn't do that, and I think that

1 has -- the unwillingness to bring over that aspect of
2 the PIRT process gets you into this ranking of opinion
3 -- opinion things in a non-transparent way.

4 VICE CHAIRMAN WALLIS: In this thermal
5 hydraulics, there's a kind of discussion about the
6 technical stuff. People make presentations and you
7 look at this. So you sort of -- you are informed when
8 you --

9 DR. NOURBAKSH: You are well informed,
10 and there is a code. You have a lot of sensitivity
11 calculations in front of you.

12 MEMBER POWERS: Right.

13 DR. NOURBAKSH: When you are going to
14 something you don't have a code for it -- for example,
15 advanced reactors -- and you don't know -- you don't
16 have that much experience with some of these
17 phenomenology, it may not be as easy or at least the
18 use of this is not going to -- I mean, I don't think
19 between nine and six if you have one to 20, to me I
20 think you shouldn't give that much weight between 15
21 and 20 or 11 and 20. Maybe one is -- maybe that's --

22 MEMBER POWERS: Can you find a physical
23 phenomenon where you cannot write out a simple time
24 scaling model -- time scalable model. I mean, Zuber
25 says he can scale every damn thing in the world.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 VICE CHAIRMAN WALLIS: Can you scale
2 cracking and --

3 MEMBER SHACK: No way.

4 VICE CHAIRMAN WALLIS: -- crack growth?

5 DR. NOURBAKHS: No, not for cracking.

6 MEMBER SHACK: If I can write a partial
7 differential equation, I don't need PIRT. I'm home
8 free.

9 MEMBER POWERS: That's not really true,
10 Bill. I mean, that's --

11 MEMBER SHACK: Give me an equation. I can
12 do an awful lot with it.

13 MEMBER POWERS: You can do an awful lot,
14 and -- but they --

15 MEMBER SHACK: I know how to live with the
16 terms and equations.

17 MEMBER POWERS: I mean, why would they
18 have invented this PIRT in the thermal hydraulics
19 place, which, damn, do they have a partial
20 differential equation? They've got a hell of a
21 partial differential equation.

22 MEMBER RANSOM: Although I think in the
23 case of thermal hydraulics mostly they focused on the
24 empirical parts of it, like heat transfer
25 coefficients, triple flow models, that type of thing.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MEMBER POWERS: And I think this is not
2 different from most of these others, that the basic
3 equation you understand -- and I think my question is:
4 is there any physical phenomena where I cannot write
5 down some approximate expression for the -- for what's
6 going on? I didn't say it had to be exact. I said it
7 -- and, in fact, in the guidance on PIRT it says
8 simplified models.

9 MR. BAHADUR: And you could do order of
10 magnitude analysis to get rid of some of that, like
11 you said.

12 MEMBER SHACK: You can write down the
13 equation, but you don't know what the terms are. You
14 don't know what the constants and the coefficients
15 are.

16 MR. BAHADUR: So?

17 MEMBER SHACK: You know they're not big as
18 a house or small as a -- I think a lot of this -- I
19 mean, the thermal hydraulic people, I mean, they've
20 got these enormous partial differential equations
21 which are exact if you can solve them, but nobody can
22 solve them exactly. So -- pardon?

23 MEMBER POWERS: They're not exact.

24 MEMBER SHACK: Well, in the pure form they
25 are exact.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MEMBER POWERS: No, they're not. No,
2 they're not. They don't work after you drop out of
3 the continuum regime. And it happens to you a lot, by
4 the way.

5 MEMBER FORD: The problem I'm seeing is
6 that you're driving towards -- it does have a
7 simplified algorithm upon which we are going to make
8 our decisions -- the sensitivity to these various
9 inputs.

10 You mentioned that maybe this discussion
11 should be going towards material degradation. The
12 thing that kills us in materials degradation is that
13 one outlier like core work and core trials for BWR,
14 which does not take into account any simple
15 algorithms.

16 And under certain situations where you
17 have everything else held constant, it will be a big
18 player. If you change these other constants, it's not
19 a big player. And so it's not a simple algorithm.
20 You can't come up with simple algorithms.

21 So, therefore, you came back to the idea
22 that you were mentioning about, well, how many experts
23 do you need on this panel who understand enough of all
24 of the parameters which are important? And there's a
25 limited number of experts, and not all of them can do

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 this, even for one system, the BWR system. If you go
2 into PWRs, forget it.

3 DR. NOURBAKHS: But just give you one --

4 MEMBER POWERS: What? Do you mean there
5 are no experts in PWRs?

6 (Laughter.)

7 DR. NOURBAKHS: I don't want to go
8 through of these details of some examples that -- why
9 this AHP doesn't work. I have elaborated on that on
10 that document I gave you.

11 But since the initial development of CSAU
12 methodology and PIRT process, there are -- I mean,
13 procedures for expert elicitation. One is
14 NUREG/CR-6372 for probabilistic seismic hazard
15 analysis. There are some aspects of it which would be
16 useful that PIRT benefit from that.

17 There is a requirement for documentation,
18 the role of technical integrator or technical TFI,
19 what they call it, and different level. Some of these
20 curves, if you put two of the staff members, they
21 could come up with -- if you advance prepare that --
22 I mean, the question is -- a prudent question is half
23 of the reason as they say.

24 If you prepare the questions in advance,
25 and then you come up with the -- structure it well,

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 and then be -- you can do a lot of homework and see
2 what are the information available, where we are
3 having problem of understanding what are really the
4 main issues, then you can bring to focus better these
5 experts and get more use of the -- those times that
6 you are with expertise -- with expert, rather than
7 coming in a kind of brainstorming, half a day, one
8 day, to come up with all of these tabulations of all
9 these phenomena and parameters.

10 And you really, in the third day, you have
11 to come up with some kind of -- sometimes it becomes
12 more working than forcing them to really understand
13 what is the information and why these judgments are
14 being made.

15 Something that I found that had a
16 potential is the influence diagram. Really, this is
17 not -- it's called -- I mean, you can call it
18 cognitive mapping, you can call it knowledge mapping,
19 there's all sorts of names for this. And basically,
20 this is something that many people do it in their mind
21 anyway when they come up with some conclusions on
22 something they wanted to make a decision on the
23 judgment.

24 And these are really influence diagrams.
25 It's a good representation of major factors in the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 system and how they influence each other. So it would
2 be a network of representing the thought process of
3 the experts rather than questioning whether this is
4 important on -- with the directive to figure of merit
5 and say why it is important. This impacts this. This
6 impacts this.

7 If it is material degradation, you go to
8 a little bit of microstructure question -- impact on
9 boundaries or whatever. If it is thermal hydraulics,
10 you go to really much more sub-issues. So it would be
11 a network of notes which represent the factors of
12 importance to the issue, and the directed arc shows
13 the influence.

14 The qualitative system analysis is in its
15 infancy. But there are a lot of good techniques they
16 are using that we can use that. For example, you
17 could actually -- a lot of this impact or influence,
18 in our field at least, is monotonic. You can say if
19 you increase the temperature, you increase the
20 potential. You could see the trend.

21 So you can put on this directed arc a plus
22 or minus. That the negative impact -- you increase
23 one, you decrease that. And then, you could put a
24 level -- high, low -- qualitatively. And that
25 qualitative influence diagram has been developed,

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 which is -- should look at the potential for this.

2 But even graphical presentation of the
3 implicit assumption that experts make the minimal
4 would be a much more transparent product than a table
5 with a series of HL or 1, 2, 3, 4, 5, in front of
6 them, and then I have to dig up the supporting
7 documents. Sometimes it is not even there.

8 The example -- it's not really -- I mean,
9 I wanted just to put an example. For example, this is
10 a technical issue and objective, and then you have
11 your hardware. And these are the boundary conditions.
12 The break size or break location or whatever -- each
13 of them influence all of these networks. It's not
14 clear here, you know, why.

15 But, for example, you put different
16 processes, phenomena, parameters, and how they impact
17 each other. As I say, you can put a plus here or
18 high, low, and then how these finally impact my figure
19 of merits. So you make question -- which one is
20 important? Which is not? So there's a network of --
21 and they each have a different opinion you can
22 capture, why these phenomena were important to figure
23 of merits, why some experts, why not other experts.

24 MEMBER FORD: For instance, in materials
25 degradation --

1 DR. NOURBAKSH: Materials degradation,
2 here you have your stressors. You have temperature,
3 water chemistry, you have your --

4 MEMBER FORD: But all of the figures of
5 merit, which I'm assuming --

6 DR. NOURBAKSH: No. The figures of merit
7 would be -- three figures of merit. You can still
8 influence these things.

9 MEMBER FORD: Yes. But the figures of
10 merit, the numbers you are going to put in each box
11 that --

12 DR. NOURBAKSH: No, no, they are not
13 numbered. It will be what -- you have an assessment
14 like a matrix of influence of each on all of them, and
15 eventually on these.

16 MEMBER FORD: Yes. But all of those
17 figures --

18 DR. NOURBAKSH: Yes.

19 MEMBER FORD: -- you have put in those
20 boxes are going to change depending on the values that
21 you put in the other boxes. You're going to have a
22 huge interacting -- it's a pulsating machine. It's
23 going to change. So how -- and it's going to change
24 depending on the system of --

25 DR. NOURBAKSH: No. All I'm -- yes. So

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 that --

2 MEMBER FORD: How do you put that --

3 DR. NOURBAKSH: There is -- actually, I
4 can refer you to papers recently published to address
5 that issue, that -- on the qualitative influence
6 diagram. That when you have one it's impacted by
7 impact of the others, basically, or synergistic
8 effects you could capture them. There are even --

9 MEMBER FORD: And they can all change
10 depending on the values put in the other boxes. They
11 would all --

12 DR. NOURBAKSH: Yes.

13 MEMBER SIEBER: Well, you're more
14 interested in their relationships than you are what
15 snapshot you're taking --

16 DR. NOURBAKSH: But as the first step you
17 wanted to identify the important parameters,
18 basically.

19 MEMBER POWERS: Peter, I guess I have two
20 questions. I fail to understand what I'm supposed to
21 learn.

22 DR. NOURBAKSH: Let me give you a better
23 example, if it's not clear here.

24 (Laughter.)

25 MEMBER POWERS: Well, that'll straighten

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 it out.

2 DR. NOURBAKHSH: No, no, no, no, no,
3 because you cannot read it. I mean, I don't know
4 whether --

5 (Laughter.)

6 MEMBER POWERS: I mean, let me ask Peter
7 a question here, because you see the complexity of
8 corrosion, and I see the simplicity of it. You know,
9 if they're going to ask you a question, "Gee, Peter,
10 is temperature important or not?"

11 MEMBER FORD: In certain circumstances,
12 yes. In others, no.

13 MEMBER POWERS: We are talking -- if you
14 looked at the process, they would say, "We are talking
15 about a boiling water reactor operating at the Browns
16 Ferry site, the BWR 4, its 22nd year of life, and it's
17 operating at full power."

18 MEMBER FORD: And a constant load and --

19 MEMBER POWERS: Yes.

20 MEMBER FORD: -- degrees Centigrade, to
21 define --

22 MEMBER POWERS: Yes. You define the
23 scenario.

24 MEMBER FORD: And if you go into
25 shutdown --

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MEMBER POWERS: No, no, I didn't ask you
2 anything about shutdown.

3 DR. NOURBAKSHSH: No.

4 MEMBER POWERS: I only asked you about
5 this scenario. I asked you the temperature and --

6 MEMBER FORD: Under that defined system,
7 as a variable, no.

8 MEMBER POWERS: Okay.

9 MEMBER FORD: Because you --

10 MEMBER SIEBER: How about the cracking
11 they had at Davis-Besse? Was temperature important?
12 Right? Was pressure important? No.

13 MEMBER FORD: Okay.

14 MEMBER SIEBER: Is the heat number
15 important? Composition? Chemistry?

16 DR. NOURBAKSHSH: Okay. So you're going to
17 have a different diagram for each component.

18 MEMBER POWERS: If you look at the -- what
19 they did for the fuel, the high burnup fuel, they
20 said, "Okay. Were high burnup fuel PWRs, ATWS, BWRs?"
21 I mean, they were very, very specific. And within
22 those things they looked at a specific plant.

23 MEMBER FORD: So you could have a whole --

24 DR. NOURBAKSHSH: For each component you
25 will have one of these, and --

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MEMBER FORD: -- and each operating
2 condition will -- sorry.

3 DR. NOURBAKSHSH: Operating conditions are
4 fixed. When you are saying, for example, this is the
5 reactor pressure vessel or upper head, or whatever,
6 you know what is the environment that this is exposed.
7 You know the temperature. You know the water
8 chemistry. The variability between the fleet is not
9 really that much.

10 MEMBER FORD: So for every system, defined
11 system condition -- material, fabrication,
12 composition, blah, blah, blah --

13 DR. NOURBAKSHSH: You put everything which
14 you define the environments, yes.

15 MEMBER FORD: Okay, fine.

16 DR. NOURBAKSHSH: And then, you put the
17 degradation mechanisms here or -- and then the figure
18 of merits, what you want it to do, potential for
19 initiation, potential for detection.

20 MEMBER FORD: You can fill those --

21 DR. NOURBAKSHSH: The time before the
22 initial -- whatever.

23 MEMBER POWERS: And what I'm struggling
24 with --

25 DR. NOURBAKSHSH: You can put multi figure

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 of merits, basically.

2 MEMBER POWERS: What I struggle with
3 heroically is, what am I supposed to do with this Chef
4 Boyardee factory that you've stuck up here?

5 DR. NOURBAKSHSH: Which one?

6 MEMBER POWERS: I mean, it takes me an
7 hour to sort out where all of the effort is going. I
8 mean, why is --

9 DR. NOURBAKSHSH: Okay. No, no, no, no.
10 I transferred this to a matrix for you. This matrix
11 would be a square matrix. You knew the impact -- when
12 it is zero, you see it doesn't have impact. And then,
13 you put high, low, or one to six, whatever you want.
14 They call it a super matrix.

15 MEMBER POWERS: Okay. Now, what's
16 different between a matrix and a tabulation that has
17 high, medium, and low on it?

18 DR. NOURBAKSHSH: You see the impact of
19 each phenomena to others, each sub-issue. For
20 example, you see the impact --

21 MEMBER POWERS: Give me an example.

22 DR. NOURBAKSHSH: Example. You see
23 flashing is important. You see why it is important.
24 Because flashing you see the impact of flash --
25 depressurization on flashing.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MEMBER POWERS: The impact of flashing on
2 flashing?

3 DR. NOURBAKSH: And then -- no.

4 MEMBER POWERS: I mean, that's --

5 DR. NOURBAKSH: For example, you went for
6 a small break LOCA. Let me talk about small break
7 LOCA. Small break LOCA basically you will have to
8 look on the peak clad core uncovering. Basically, you
9 are looking at depletion of water or addition of
10 water, one of these two issues.

11 So when you are flashing, you remove
12 water. At the same time when you flash, you
13 pressurize. That pressurization has an impact --
14 well, I'll come to that example.

15 This is like AP600, and then I come back
16 to here. This is different than -- I don't know why
17 I don't see that line yet. It's different than --

18 MR. CARUSO: I think what he's trying to
19 do is he's trying to explain this is a documentation
20 process. Okay. Very often --

21 DR. NOURBAKSH: This is implicit --
22 exactly. If they are not different than PIRT --

23 MR. CARUSO: Right, right.

24 DR. NOURBAKSH: -- captures implicit
25 assumption.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MR. CARUSO: Very often you get these
2 groups of wise men together that produce pearls of
3 wisdom, and the pearls of wisdom may be wonderful but
4 people don't always understand how they arrived at
5 those pearls of wisdom. And this is just a way to try
6 to explain and document how those pearls of wisdom got
7 generated. Does that make sense?

8 MEMBER POWERS: If this is an effort to
9 communicate, I know one individual that it's just
10 failing terribly on. Okay? Because all I'm doing is
11 I'm getting dizzy finding out -- I mean, there's
12 nothing linear about this.

13 DR. NOURBAKHS: That is exactly what I
14 was trying to say. It's not linear. It has a lot of
15 feedback effects and a lot of --

16 MEMBER RANSOM: Well, it seems to me
17 you're moving away from the purpose of PIRT, though.
18 The purpose of PIRT was simply to, in a qualitative
19 framework, to reduce the number of variables, you
20 know, that you must look at.

21 DR. NOURBAKHS: That is what these are.
22 I took it from the table. It's half of that table.

23 MEMBER RANSOM: This is beginning to look
24 like --

25 DR. NOURBAKHS: This is why it is

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 important to my figure of merits here.

2 MEMBER POWERS: If you see that, I would
3 surely like you to tell me how you see that.

4 VICE CHAIRMAN WALLIS: This looks to me
5 like the beginnings of a system dynamics model for
6 LOCA, which is a kind of --

7 DR. NOURBAKHS: Yes, qualitatively.

8 VICE CHAIRMAN WALLIS: -- pseudo code
9 where you write down all of these boxes and --

10 DR. NOURBAKHS: Exactly.

11 VICE CHAIRMAN WALLIS: -- say this one
12 affects this one. Instead of writing equations, you
13 write a simple thing -- this one --

14 DR. NOURBAKHS: Exactly.

15 VICE CHAIRMAN WALLIS: -- when this gets
16 bigger, that gets smaller, and here's --

17 MEMBER POWERS: Well, that's the idea
18 behind neural networks, and that's what it's beginning
19 to look like. We are simply putting --

20 DR. NOURBAKHS: That's exactly what it
21 is.

22 MEMBER POWERS: -- of all of the
23 effects --

24 DR. NOURBAKHS: We are not saying that --
25 we are not substituting these two pairs. We are

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 saying this is a better way of presenting it. This
2 way you force the experts to give you the exact
3 rationale for their importance.

4 MEMBER POWERS: If you presented that to
5 me, one of two things would happen. I would be
6 abusive, or I would just turn you off. There is
7 nothing being communicated here.

8 VICE CHAIRMAN WALLIS: Don't put him on a
9 PIRT panel.

10 (Laughter.)

11 MEMBER POWERS: Well, that's the for God's
12 sake truth. Don't ever put me on another one, because
13 I'm so disgusted with what I see as the real problems
14 with it, but I --

15 DR. NOURBAKSHSH: Are you comfortable with
16 the table having a phenomena versus other phenomenon
17 figure of merit at the end? And then, you see the
18 importance of each relative to other ones. I mean, go
19 through a matrix. The column and the -- that's
20 exactly what it is.

21 MEMBER POWERS: It's wonderfully
22 efficient. It's much more useful to me --

23 DR. NOURBAKSHSH: Yes, yes.

24 MEMBER POWERS: -- than this.

25 DR. NOURBAKSHSH: It's much more useful.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 That's being transferred to a matrix, basically.

2 VICE CHAIRMAN WALLIS: Well, it's a multi-
3 dimensional matrix that you're talking about.

4 DR. NOURBAKHSB: But you don't have to do
5 it if you wanted to actually -- one way of doing it --
6 doing it in multi-layers. A square matrix of
7 identical items and figure of merits.

8 MEMBER FORD: But this idea of a square
9 matrix with figures of merit, and just coming up with
10 a number off the table, that assumes that it is
11 linear. It assumes that you've got a simple
12 linearized --

13 DR. NOURBAKHSB: No, no. All that's in
14 the matrix -- you put high, low, or important -- low
15 importance, high importance, or no relevance. You put
16 zero. So you see what impacts what, what influences
17 what, and how these influence the figure of merits.

18 MEMBER FORD: Okay.

19 DR. NOURBAKHSB: That's basically
20 capturing implicit assumptions that an expert makes.
21 And then you can make that one, based on that, which
22 experiment in that matrix -- you can actually fill
23 that up, which experiment or which analysis or what is
24 your rationale for that, in a very much transparent
25 way.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MEMBER LEITCH: So every one of those
2 arrows, then, would have not only a direction
3 associated with it, but a relative importance
4 essentially.

5 DR. NOURBAKSH: Importance, yes.

6 MEMBER LEITCH: Okay.

7 MEMBER POWERS: Your matrix idea is vastly
8 superior to this, because --

9 DR. NOURBAKSH: Yes. These are very
10 difficult actually to produce even, but one way of
11 making -- simplifying it, making multi-layers, top-
12 down approach basically. You put the basics and then
13 open the box to go to more details if you want it, to
14 present this. But I wanted to present it a little bit
15 more --

16 MEMBER POWERS: Apostolakis loves these
17 diagrams. And every time he puts one up, I just throw
18 things at it.

19 VICE CHAIRMAN WALLIS: It's more the
20 system dynamics people who love these, and this is all
21 they do is draw things like this.

22 DR. NOURBAKSH: That's what it is.
23 That's basically the relevance there on --

24 MEMBER POWERS: If you can replace this
25 with a two-dimensional matrix --

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 DR. NOURBAKSH: But that --

2 MEMBER POWERS: -- where I can readily
3 ready the fact that the liquid inventory depletion has
4 nothing to do with the IRWST injection.

5 VICE CHAIRMAN WALLIS: But the problem is
6 you've been brought up in these American cities where
7 all of the streets are a rectangular pattern. This is
8 more like a traditional European city, where there are
9 all kinds of ways to get from here to there.

10 MEMBER POWERS: But we know that the
11 topologists discovered that in Gurtenburg there was
12 not a way to get there without crossing the bridge
13 twice, right?

14 (Laughter.)

15 VICE CHAIRMAN WALLIS: Well, you may find
16 the same is true here. I mean, you can --

17 MR. CARUSO: We actually saw one of -- we
18 actually saw something like this -- that this week at
19 the fuels meeting. Do you remember the slide that
20 they put up about how the fuels codes interacted with
21 one another? You weren't there, but it -- you were
22 there, Peter, and that -- I mean, it looked just like
23 this. It was a spaghetti network.

24 MEMBER POWERS: We said abusive things to
25 them about it.

1 MR. CARUSO: And we said abusive things to
2 them. But the point was to show that there were a lot
3 of different factors that interacted with one another
4 in ways that may not have been entirely obvious to the
5 uninitiator.

6 And they were just trying to explain that
7 this is a complex scenario, this is a complex issue,
8 and there are a lot of different players. That's all
9 they're trying to do.

10 MEMBER POWERS: In the fuel area, you
11 know, they're trying to say, "Hey, don't go look at
12 this, because it's so complex you'll never understand
13 it."

14 MR. CARUSO: Well, you know, that's not a
15 good thing to say.

16 MEMBER POWERS: Well, I mean, that's what
17 they're deliberately trying to say. And I think
18 that's what this kind of diagram does. It says -- it
19 emphasizes the complexity rather than the simplicity.

20 MEMBER SIEBER: Yes. It's to impress.

21 MEMBER POWERS: Well, I mean, these are
22 all pretty simple systems.

23 CHAIRMAN BONACA: Well, in slide 17 you
24 strike a -- you make another statement regarding IDs.
25 Do they help -- so that the individual expert can make

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 a judgment in their own areas of expertise without
2 making any implicit subjective judgment on the
3 importance of other phenomena? That was the problem
4 you told me.

5 DR. NOURBAKSHSH: Yes.

6 CHAIRMAN BONACA: Could you elaborate on
7 that, explain to my why it is.

8 DR. NOURBAKSHSH: These are, again --

9 CHAIRMAN BONACA: Take the Figure 14.

10 DR. NOURBAKSHSH: I mean, this is a very
11 simple system. But suppose some experts are -- these
12 are some of the chemistry issues found in here. Some
13 of them are hydraulics issues here. And they are all
14 interactions between there. So you get only expert
15 opinion and elicitation on these interactions, which
16 is chemistry, without the -- just makes the importance
17 to this without saying how important this is to this,
18 because --

19 CHAIRMAN BONACA: Okay.

20 DR. NOURBAKSHSH: -- you have to integrate
21 all of these different expertise to the figure of
22 merit.

23 MEMBER FORD: But in order to do the
24 interrelationships between that block and this block,
25 you need a model to start with.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 DR. NOURBAKSH: It's not a model. You
2 can do it qualitative as the PIRT are doing, just
3 making the importance. This is important, this is
4 important, and there are --

5 MEMBER POWERS: I like the way we do it on
6 the source term, Tom, which they -- I'll vote for five
7 percent, Tom says six percent, Jim Gesecky says seven,
8 and the French guys says, "No, I'll bid eight and a
9 half," and so he wins because he got the highest
10 number, right?

11 MEMBER KRESS: This, though, reminds me of
12 the decomposition process they did for 1150. They've
13 taken the complex thing and decomposed it into its
14 parts. And then you could let the experts vote on
15 different parts of this.

16 For example, just looking at the one that
17 he's got up there, let's say our interest was in the
18 minimum vessel core inventory. We've only got two
19 arrows feeding into that. One of them is makeup, and
20 one of them is depletion. Well, on each arrow you put
21 a .5.

22 Then, you go to the liquid inventory
23 depletion, you've got one, two arrows going into it,
24 core flashing and core voltage. Well, core flashing
25 gets rid of maybe a tenth of the fluid, and core

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 voltage gets rid of nine-tenths of it. So I'd put .9
2 and a .1 on that.

3 I'd start working my way up this thing,
4 and I'd have numbers on each one of these things. And
5 eventually I think you can combine those numbers and
6 -- to get an importance measure for each one of these
7 things on the bottom thing you're interested in.

8 CHAIRMAN BONACA: They're trying to make
9 it look like a PRA is what --

10 MEMBER KRESS: Yes. I think he has an
11 idea here that's worth pursuing. You know, you have
12 to be sure you get all of these lines right, and all
13 of these items on here right.

14 VICE CHAIRMAN WALLIS: That's what system
15 dynamics people do -- accept and consider these .9's
16 or .1's. They have a kind of equation, and it's
17 either a differential or it's a linear thing, which
18 says that --

19 MEMBER KRESS: Yes. I've replaced this
20 with --

21 VICE CHAIRMAN WALLIS: -- by a certain
22 amount of --

23 DR. NOURBAKHS: That decomposition comes
24 to your mind if you -- I mean, you do it mentally.
25 You have this picture basically, may be a simple way

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 of --

2 VICE CHAIRMAN WALLIS: How is --

3 DR. NOURBAKSHSH: -- to come up with these.

4 And if they're writing for the rationales, they have
5 to explain all of these things, if they have done it
6 correctly. But you force them to -- explicitly to
7 be --

8 MEMBER KRESS: You'd have to have some
9 sort of mental model of some of these things and
10 integrate with time, actually, with them. I think it
11 could be useful.

12 DR. NOURBAKSHSH: They do it at different
13 times. That's how --

14 MEMBER KRESS: Do it at different times,
15 yes.

16 DR. NOURBAKSHSH: Different times which are
17 -- the dominant phenomena are not changing, basically.
18 That's how they do it for small break LOCA, initial
19 blowdown and then different phases.

20 But instead of voting which phase is
21 important, each phase provided the condition to the
22 second phase. You cannot say the way they did it for
23 AP600. The initial blowdown is not important. It may
24 provide some initial condition to initial -- IRWST
25 initiation, for example, phase or ADS blowdown phase.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 But there are some actually available --
2 you can put all of these things there top-down. You
3 will put them in smaller boxes, open them. I mean,
4 the agency actually is talking about knowledge
5 management initiatives, that they wanted to capture
6 the infrastructure of knowledge that --

7 VICE CHAIRMAN WALLIS: This is an
8 iterative process. I mean, if you're going to do a
9 new analysis of a new reactor with thermal hydraulics,
10 you might start like this. And this tells you the
11 things you have to worry about in your code. So you
12 set up the code, and then you run it and you do all of
13 these things, and you say, when I've done all of this
14 stuff with the code, did it have the sort of -- did
15 the pieces have the importance that I thought they had
16 when I started out? You've got to go back to the
17 loop-around.

18 MEMBER KRESS: Yes.

19 VICE CHAIRMAN WALLIS: That's the thing I
20 criticized them for. They treated it as sort of a
21 linear process. But the experts set up the PIRT, and
22 if the expert opinion was wrong, and the code shows
23 it, it never gets fed back at the beginning again.

24 MR. CARUSO: But you should even be doing
25 this as a design. This is the way an engineer should

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 do a design of anything. You come up with a model in
2 your mind, you write it down, you think about it, and
3 you iterate it. You have to do that.

4 DR. NOURBAKSH: And then, when you wanted
5 to do code verification, it's not whether these
6 phenomena are important. It's whether these
7 phenomena's dependency on other variables is rightly
8 captured in the code.

9 The code may have all of these phenomena,
10 but the dependency may not be there. The important
11 difference is that we've captured it there.

12 VICE CHAIRMAN WALLIS: You know, it has
13 condensation but it doesn't consider the effect of the
14 non-condensables, for instance.

15 DR. NOURBAKSH: So you don't have to have
16 a busy slide like this. You can go top-down,
17 basically. If you do it correctly, you can go -- you
18 can derive this -- the top-down scaling from these
19 diagrams basically, what are the input and output.

20 VICE CHAIRMAN WALLIS: Are you saying that
21 the experts together make up this massive diagram?

22 DR. NOURBAKSH: No. What I'm saying is
23 you do advance preparation based on the knowledge, and
24 then put that matrix in front of them, and you come up
25 with some suggestions even if you want based on the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 information.

2 VICE CHAIRMAN WALLIS: Well, I could as an
3 expert say, "Look here, you've missed out on one of
4 these blocks, and you can't put it in."

5 DR. NOURBAKSH: The complete list, you
6 can look at it. With a matrix, you could see, okay,
7 this condensation has an effect on this. I don't see
8 it in the matrix. This is zero. I have to change it
9 too high. And sometimes there are different opinions.
10 Then you know what to expect, where they are
11 different. It's more transparent.

12 When you do -- if you have a diagram like
13 this, a draft final, then when you have a test you
14 know the test addressed this part of the diagram
15 basically, addressed this phenomena, this phenomena,
16 and this phenomena. Then, you could see what are the
17 important boundary conditions for this test, whether
18 this test really scales well or not. You know what
19 are the important parameters that should come to the
20 test in order to address this issue.

21 If you need to do a little bit more work
22 -- but I think it's payoff as well as transparency of
23 the result or capturing the implicit assumptions. And
24 then, revision would be much easier. As you learn
25 more, you can go back and update these things much

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 easier than updating a pair.

2 You cannot just change one of these high
3 to low based on one experiment. You know exactly I
4 have learned now -- for each of these arrows, you can
5 actually ask the level of knowledge, too -- high, low,
6 no, or whatever. And then you can capture later on
7 where there is importance and high uncertainty. When
8 we have more knowledge, you go back and redo this.

9 VICE CHAIRMAN WALLIS: Okay.

10 DR. NOURBAKHS: So with each directed
11 arc, you can ask three questions -- how important it
12 is, the rating which is very much positive, negative,
13 then you could see the compensating effect sometimes,
14 in some tests or something like that. And then, the
15 third question the level of knowledge.

16 Actually, something like that has been
17 done for when they were assessing the impact of Clean
18 Air Act, basically, the process of issues. And DOE
19 actually sponsored something like that, and they
20 actually were in their -- defending their approach.
21 They were saying that we are not generating a black
22 box. This is a glass box. You see everything.

23 VICE CHAIRMAN WALLIS: Okay.

24 DR. NOURBAKHS: So as I said, this
25 provided a better -- a good context for capturing the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 implicit assumptions. And they are more transparent,
2 these things, than a table for revision. I mentioned
3 that -- how these diagrams could be used when you have
4 different expertise on different areas in multi-
5 disciplinary type of issues.

6 And if you wanted, really, to do a ranking
7 of these processes, there are tools available which
8 are basically looking at this super matrix that I
9 mentioned and trying -- again, pair-wise ranking of
10 the super matrix, and then come up with the
11 prioritization of each phenomenon or processes.

12 Basically, what you could make the case
13 for -- I mean, you take into account all of the
14 feedback effects and the interactions between all of
15 these phenomena.

16 And, basically, that summarizes my
17 presentation.

18 CHAIRMAN BONACA: Very interesting.

19 MR. CARUSO: Can I just add one more --
20 I'm sorry. I just wanted to add one more comment.
21 The former regulator -- when I used to say the word
22 "PIRT" to the industry, this is what they used to
23 think of, and this is what caused them all sorts of
24 aggravation. I used to think this and see dollar
25 signs.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 We also used to tell them that PIRT could
2 consist of two engineers sitting around a table one
3 afternoon listing everything that was important. And
4 if that worked, that was just as much a PIRT as this,
5 they thought. And I just throw that out as an
6 observation. I think this is a great idea, but this
7 is just one thought of PIRT in a whole park of
8 potential PIRTs.

9 DR. NOURBAKSH: And then, if you have
10 that super matrix, you can put the initial of
11 experiment in the similar super matrix. You see this
12 experiment address the impact of this to this to this
13 to this, where we have missing -- where we are missing
14 as far as database.

15 VICE CHAIRMAN WALLIS: What you're saying,
16 I think, is that this isn't just at the PIRT stage of,
17 say, evaluating a code. There is also the validation.
18 There's the comparison with experiment. You can do --
19 you can use this kind of thing as well. You can say,
20 "I've got this experiment."

21 DR. NOURBAKSH: Yes.

22 VICE CHAIRMAN WALLIS: "How does it fit
23 into this kind of a picture? Which of these boxes
24 does it give me information about?"

25 DR. NOURBAKSH: Exactly.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 VICE CHAIRMAN WALLIS: Right. And that
2 might be helpful when we're looking at review of
3 AP1000 and we're saying, "Look, you're saying these
4 experiments are adequate. But which of them has any
5 relevance to this piece down here which, you know,
6 PIRT says is important?"

7 DR. NOURBAKSH: These experiments address
8 these issues. But the boundary conditions are very
9 transparent, what -- you should be using that
10 experiment as a boundary condition, but that you are
11 actually addressing that or not, it's there or not in
12 the test -- separate effect test facilities,
13 basically.

14 MEMBER POWERS: Well, thank you. That's
15 interesting, and I appreciate your -- quick couple of
16 other questions that come to mind on this. Suppose
17 that I'm the NRC, and I wanted to do a PIRT on what's
18 important in a system. If you get two people together
19 like Peter and I, because we see eye to eye and agree
20 on everything so completely, that obviously gives you
21 an inadequate PIRT, especially in controversial areas.

22 So you want somebody with orthogonal views
23 on things, or different views on things. And there's
24 going to be a third person into this thing, and you
25 know that Peter and I are such nice guys that we won't

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 browbeat that fellow. So it's okay.

2 What is the proper size of a PIRT panel,
3 without getting too unwieldy? If I have -- if I
4 invite the nuclear engineering faculty of all of the
5 nuclear engineering schools in the United States to be
6 on the PIRT, that's probably the unwieldy.

7 DR. NOURBAKHSH: Previous experience, at
8 least from what I read, some of the Brits' and Gary's
9 work, is that more than four or five was very
10 difficult to get consensus. That's why even in the
11 burnup credit they came up with voting, basically.
12 They were not really -- they could not make -- when
13 you have 20 in the room, it's very hard to make a
14 consensus on the issues.

15 But this way, you are forced to elucidate
16 the information more rather than elucidate personal
17 opinion. You base it on some information that should
18 be there. And then, when you could see exactly where
19 the holes are, where the missing knowledge is, impact
20 of what on what, rather than -- you could see why
21 these phenomena some people voting it six, the other
22 one three. It's a little bit -- they may have the
23 same opinion on interactions, and this is a better
24 tool for consensus-building, too, in a way.

25 MEMBER FORD: But you say when you have a

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 large number of people -- I can understand from a
2 decision-making process it is sometimes bad. The
3 Brits, when they do their materials -- provide to the
4 materials degradation planning for their defense
5 reactors, lightwater reactors, they use 20, 30 people
6 on the panel, put all of the relevant data on the
7 table, and then they discuss as a group as to the
8 relative importance of those packets of data. And
9 they do it very much quicker than one year. They do
10 it in a month.

11 DR. NOURBAKHSH: But their preparation for
12 that meeting may be quite -- more substantial than
13 what we do for PIRT here. If you prepare it well in
14 advance, and you know exactly what the data is, where
15 the missing elements are, the knowledge base is, and
16 the rationales, a few technical staff could sit down
17 -- which are knowledgeable on the whole integrated
18 issues, basically, a generalist who could sit down and
19 develop the initial structure and the importance. And
20 then, when you have the experts it doesn't take that
21 much time, because you start with a much focused kind
22 of agenda.

23 VICE CHAIRMAN WALLIS: Do the Brits make
24 more use of academics?

25 MEMBER FORD: Yes.

1 VICE CHAIRMAN WALLIS: I think you need
2 some reality check on this. There's nothing like
3 having a --

4 (Laughter.)

5 Yes, I mean that seriously. I mean, I
6 think you get people who have been in the business all
7 of their life. They always think that A, B, and C
8 influence D, because it has always been that way. And
9 to have to explain that to some, you know, fair,
10 honest, you know, knowledgeable, smart enough -- if
11 there are any like that -- academics, you know, is a
12 very good discipline to have.

13 It's a representative of the outside
14 world, and it's useful to have that sort of person --
15 or not someone who is egocentric and all of that kind
16 of nonsense that you find in academics, but someone
17 who is willing to balance information and say, "You
18 told me this. Now convince me." That sort of thing.
19 So I would just look for that kind of representation
20 on a PIRT panel.

21 MEMBER KRESS: Give them a psychological
22 test first?

23 DR. NOURBAKHS: Yes.

24 VICE CHAIRMAN WALLIS: Well, the problem
25 in this country with the nuclear business is that

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 everyone is corrupted. And everyone who is an expert
2 has been hired by either the industry or the NRC.

3 MEMBER KRESS: Right.

4 VICE CHAIRMAN WALLIS: It's very difficult
5 to find anybody who you can say is independent.

6 MEMBER KRESS: They're all corrupt, that's
7 right.

8 VICE CHAIRMAN WALLIS: They're all
9 corrupted.

10 CHAIRMAN BONACA: Any other questions for
11 Hossein? Thank you for your presentation. I think it
12 was informative and timely, and we'll see some results
13 soon.

14 So with that, we have on the agenda here
15 -- we have presenters, but we have also breaks. So I
16 see that there is an intense desire for the members to
17 take a break, so let's get together again at five of
18 2:00.

19 (Whereupon, the proceedings in the
20 foregoing matter went off the record at
21 1:40 p.m. and went back on the record at
22 1:55 p.m.)

23 CHAIRMAN BONACA: Okay. We can get back
24 into session.

25 The next presentation that we have today

1 is on Operating Experience Assessment Report - Effects
2 of Grid Events on Nuclear Powerplant Performance. And
3 we have I believe two presentations.

4 MEMBER LEITCH: Yes, that's right.

5 CHAIRMAN BONACA: All right. All right?

6 MEMBER LEITCH: All right.

7 CHAIRMAN BONACA: Yes.

8 MEMBER LEITCH: Go to me first?

9 CHAIRMAN BONACA: Sure.

10 MEMBER LEITCH: This operating experience,
11 this particular quarter we thought it was important to
12 just talk about switchyard- or grid-related scrams.
13 And there's a couple of different components to that
14 discussion.

15 Let me remind you that we had a discussion
16 of this -- generally of operating experience with the
17 plants in the July timeframe. And during that time it
18 appeared to us as though there was some indication
19 that there were an increasing number of what I call
20 switchyard-initiated scrams. And I'll explain in a
21 minute what I mean by that term.

22 We were not sure that it was statistically
23 significant, but during that particular three-month
24 time period leading up to July there was perhaps 13
25 automatic scrams. And I think we -- there were about

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 seven of those that were related to switchyard issues.

2 And by "switchyard issues," I mean those
3 things that are beyond the generator breaker, let's
4 say, disconnect switches, main transformers, lightning
5 arresters, protective relay actuations or
6 misactuators, grid reliability problems regardless of
7 their cause, and so forth.

8 And so we thought that we would keep an
9 eye on that thing for a while and see if there
10 continued to be a trend. And, indeed, it seemed like
11 the trend was continuing. For example, there was a
12 two-week period in -- towards the end of July where
13 there were three scrams from 100 percent power due to
14 grid problems. And I've listed them here as to which
15 ones those are, and I'll go into that in a minute.

16 But we're concerned about these issues,
17 because when a plant is running along at 100 percent
18 power, and the generator breaker or breakers open,
19 there is a significant challenge to the plant. There
20 are robust safety systems that are designed to cover
21 the plant in that situation and protect the plant in
22 that situation, obviously. But it does challenge a
23 great deal of those safety systems.

24 So as a result of that, we thought we
25 would have some kind of a presentation, and then in

1 the more recent days there has been some fairly
2 significant events occur. So I'd just like to go
3 through just a couple of the -- just to mention a
4 couple of the events, so that you get an idea of what
5 we're referring to here, a couple of the events that
6 have occurred in the fairly recent history.

7 On July 22nd, at Peach Bottom Number 2,
8 there was a main generator protective relay actuation
9 and a unit scrambled from 100 percent power.

10 Palo Verde, on July 28th, there was a grid
11 perturbation problem, and the one unit scrambled and it
12 sounded like they were very close to losing all three
13 units. But it turned out just to be one unit
14 scrambled.

15 Salem Number 1 on July 29th, there was a
16 500 KV circuit breaker failure, and it tripped the
17 unit there. They declared an unusual event.

18 And since that time, there have been a
19 couple more. On August 3rd, there was a loss at
20 Indian Point Number 2. There was loss of all load and
21 the reactor scrambled from 100 percent power.

22 And, of course, the one that we're all
23 familiar with -- that's August 14th -- in the
24 northeast blackout there were nine nuclear plants that
25 went down due to loss of offsite power events.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 On July 8th, there was an automatic scram
2 from 100 percent power at LeSalle due to a fault in
3 the main power disconnect.

4 One that may be a little bit of an
5 outlier, on August 23rd at Wolf Creek, there was -- a
6 cropduster plane flew into a 345 KV line, and the
7 plant had to quickly reduce power. They did not scram
8 on that occasion, but I don't know how the cropduster
9 made out. But the plant stayed online.

10 ANO Number 1, on August 29th, there was an
11 automatic scram from 100 percent power, and that was
12 caused by tripping of the main generator breaker, or,
13 actually, the turbine tripped and the main generator
14 breaker failed to trip, and they had to manually open
15 the main generator breaker to prevent motoring of the
16 generator.

17 VICE CHAIRMAN WALLIS: How quickly could
18 they do that? They have to act pretty quickly, don't
19 they?

20 MEMBER LEITCH: Yes, right. Right. This
21 is one of the challenges I'm referring to, yes. And,
22 in fact, one of the challenges is when the main
23 generator breaker opens, all of the turbine valves
24 have to go closed or else you get a turbine overspeed
25 situation.

1 On September 15th, there was an unusual
2 situation at Peach Bottom. There was actually a dual
3 unit scram, both units from nominally 100 percent.
4 One was a little less than 100 percent due to an
5 electrical transient, and there were some subsequent
6 problems with diesels -- with a diesel generator and
7 a safety relief valve stuck open. And there was an
8 AIT. In fact, I think there presently is an AIT there
9 at Peach Bottom. I don't think we know the
10 conclusions of that yet.

11 VICE CHAIRMAN WALLIS: Well, these events
12 advise us of latent problems, like if the SRP is stuck
13 open you could say it was a latent --

14 MEMBER LEITCH: It was a latent problem,
15 yes. It was not related to the scram directly, not --
16 so far as I know, nor was the diesel -- I think all --
17 my impression is that all four diesels started and
18 then one tripped. But I don't know the full status of
19 that investigation. It's currently ongoing.

20 On September 18th, Hurricane Isabel
21 related apparently at Surry 1 and 2. Both units
22 tripped from high power due to loss of power to all
23 circulating water pump busses. So they lost all eight
24 circulating water pumps and manually tripped both
25 units.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 On August 20th, again, apparently
2 hurricane-related -- excuse me, September 20th -- Hope
3 Creek Number 1 tripped, automatic trip from 100
4 percent power, and then later -- Salem and Hope Creek,
5 by the way, share the same site. Later that same day
6 they manually took Salem 1 and 2 out of service for
7 the -- apparently the same related situation, which
8 was a salt buildup on the bus structures.

9 So now some of these things are perhaps
10 outliers, but it certainly leads to questions about,
11 you know, if you count these up there's probably about
12 23 or so units that scrambled in the period of, what,
13 two months. And now, admittedly, there's hurricanes
14 and there's blackouts, but I guess there's always been
15 hurricanes and blackouts. You have to deal with those
16 kinds of things.

17 And one might ask the question -- is there
18 a statistically significant trend here? If there is,
19 does this represent a safety concern? Is there an
20 aging-related issue here? Are we thinking about
21 license renewal? Is there something going on here
22 that's related to the age of some of this equipment?
23 Or is there a change in utility operating practices or
24 maintenance practices with respect to some of this
25 equipment that may be leading to some of this -- these

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 issues?

2 So in that regard, we've asked the staff
3 to come in and give us a couple of presentations on
4 this topic. One has to do with the report that was
5 prepared previously. I think it was issued about
6 May 1st, and it deals with the reliability and
7 operating experience of the grid.

8 And interestingly enough, it deals with it
9 in two time periods, from about I think it's '87 to
10 '96, before a great deal of deregulation took place,
11 and it contrasts that with the experience in the
12 period from '97 through 2002. So we'll hear a little
13 bit about that report and some other information about
14 the more recent operating events that have gone on.

15 I would say that there is really two sides
16 to this problem. One is, how does the nuclear plant
17 affect the grid? And I think that's mainly what this
18 report that we're going to hear deals with, and that's
19 something that we need to be concerned about. But the
20 other side of that coin is just as important to us, if
21 not more so, and that is, how does the loss of the
22 grid for other reasons impact the operation or
23 challenge the operation of the nuclear powerplant?

24 So with that, I'd like to turn it over to
25 John Flack, who will take over from here and introduce

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 the rest of the presenters.

2 MR. FLACK: Yes, thank you, Graham. I am
3 hoping -- I'm John Flack, Branch Chief from the
4 Regulatory Effectiveness and Human Factors Branch in
5 the Office of Research. And hopefully we'll be able
6 to shed a little light on some of the questions you
7 raised here, which are very important.

8 Before we get started, though, I'd like to
9 first go over a few things. One is after I'm finished
10 Cornelius Holden is here from NRR and will bring the
11 committee up to date on what's been happening more
12 recently.

13 And as you've mentioned, Graham, this is
14 really Bill's study that we're looking at today. Bill
15 had started this a few years ago. By the way, Bill
16 came from industry with about 20 years of experience
17 when he came to the NRC in '92. And he actually went
18 to AEOD, which no longer exists as you know, but the
19 function -- part of the AEOD function did come to
20 Research and is in my branch.

21 We have a small team of about five that
22 look at operating experience and regulatory
23 effectiveness from an independent perspective and do
24 studies. And one of these studies was what Bill was
25 doing on grid, and ironically he was putting together

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 the pieces just before all of this happened. And
2 you'll see some of the things that he looked at as
3 part of his study that indicated that things were
4 actually changing out there.

5 And, really, there is a lesson to be
6 learned from that, because if you look at the
7 statistics backward-looking you may not see that
8 change. Everything seemed to be pretty much in order.
9 We were really not getting -- in fact, the number of
10 events had gone down, although we did notice that they
11 were getting longer in duration.

12 But the fact that if you look at it from
13 that perspective, you'll notice that things were
14 really changing after deregulation. And this is part
15 of what Bill will be talking about today -- how things
16 have changed, seriously changed, during and after
17 deregulation. And that's pretty much part of his
18 study.

19 So we had received a number of comments on
20 this study, and that also reflects how one sees it
21 from a different perspective. We had an example from
22 one commenter that it really didn't provide a whole
23 lot of value where from NERC -- and this is really
24 less than a month before we had the blackout event --
25 stating that the events that were cited in Bill's

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 report basically provide a wealth of information,
2 lessons learned, so it should be taken seriously and
3 acted upon by the Commission.

4 So you can see the difference of
5 perspectives, I think, that again it bears out I think
6 the fact that if the model is changing one has to
7 really look at that and not solely rely on the
8 statistics that we see from day to day. That we
9 really have to understand it in light of this changing
10 model.

11 So without holding it up any longer, let
12 me turn it over to Cornie and let him bring you a
13 little bit up to speed on what's been going on more
14 recently.

15 MR. HOLDEN: My name is Cornelius Holden,
16 and I'm Project Director for NRR. But more recently,
17 I've been working with Sam Collins as part of the task
18 group looking at blackout event, so I thought it would
19 be timely just to fill you in on task group activity,
20 and then tell you what we're doing within the NRC and
21 internal task group as well.

22 But as you're probably aware, the
23 President of the United States and the Prime Minister
24 of Canada jointly formed a review task group for the
25 blackout event of August 14th. Within that, there are

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 three working groups. There's a security working
2 group, an electric systems working group, and a
3 nuclear working group. And there is a U.S. and a
4 Canadian counterpart on each of those.

5 The chairman is in charge of the U.S.
6 nuclear working group. And during phase one of those
7 reviews, the various working groups are trying to
8 determine what happened, what caused the outage and
9 why, and why was the system not able to prevent the
10 spread of the blackout.

11 There will also be a phase two, which is,
12 how do we prevent future outages? And that will
13 involve input from a variety of stakeholders in that
14 process, and there are still details to be worked out
15 on that. So they -- like was mentioned on
16 August 14th, nine plants tripped as designed and
17 safely shut down as a result of the grid disturbances.

18 There were a number of other plants that
19 saw the disturbance nationwide, and some plants,
20 because of the way the grids operated, didn't see
21 that. So that's basically where we are on the task
22 group activity there.

23 Within NRR and Research, we have formed a
24 team to take a look at the events of August 19th, the
25 most recent events that you'll hear about, and Bill

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 Raughley's report. And we're looking at that to
2 understand what those events tell us, put it into our
3 process to determine what actions we need to take as
4 a result of that, whether it's generic communications
5 or rulemaking.

6 And we're proceeding on a schedule that
7 will allow these two -- both the task -- the
8 international task group and our working group to
9 transfer ideas from one group to the other, because it
10 may be that out of one group we have ideas for the
11 grid, and the electric working group on -- the task
12 group may have other issues that will come back, and
13 we'll have to put those into our process.

14 And with that, I just thought I'd lay the
15 groundwork for that.

16 MEMBER LEITCH: I just wanted to emphasize
17 that, you know, there's a lot higher visibility
18 nationwide I'm sure on the impact on the grid.

19 MR. HOLDEN: Yes.

20 MEMBER LEITCH: A big blackout, and so
21 forth.

22 MR. HOLDEN: Yes.

23 MEMBER LEITCH: But I think as the Nuclear
24 Regulatory Commission, we need to be looking at --
25 that is certainly important, but I want to be sure

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 that we don't lose sight of the impact that that has
2 on the nuclear powerplants. I think it's a real
3 challenge.

4 I mean, on August 14th, the plants all
5 shut down. Apparently, the diesels started reasonably
6 well, and there was no major problems associated with
7 that. But yet do that often enough and there will be
8 some problems, a la the subsequent events that have
9 happened even a couple of weeks ago at Peach Bottom.

10 So we need to be concerned about both
11 sides of that coin, I guess, not just supporting the
12 grid -- that's important -- but also if the grid goes
13 down for other reasons, what does it do to the plant?

14 MR. HOLDEN: And I think the internal
15 working group is also going to benefit from the fact
16 that many members of that group also participated in
17 the nuclear working group for the review of the grid.
18 So there will be a lot of transfer of information that
19 happens there.

20 MR. FLACK: Okay. I guess we can move to
21 Bill's presentation. Take it, Bill.

22 MR. RAUGHLEY: I'll just start with the
23 introductory slide here. The topic is grid
24 reliability issues, and people have talked about the
25 report. We're going to focus on those aspects of the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 report that deal with the changes going on. If you
2 want to talk about them more along the way, we can.

3 The topics we're going to give some
4 background in terms of why we did the report, the
5 regulatory expectations, and some background on
6 deregulation. I'm going to focus on the changes to
7 the grid. We did a little more detailed look than we
8 normally do. It was not the traditional look-see.

9 In the next three bullets we're going to
10 provide insights from the work we did, and I have some
11 backup slides, like I said, if you want to talk about
12 additional topics in the report.

13 John covered the first report, who we are
14 and what we do. How we got into this is in 1999 the
15 Commission asked the question, "Do we need to take any
16 regulatory action as a result of deregulation? And
17 what actions do we need to take to maintain the
18 licensing and design basis?"

19 And I wrote a paper and a SECY. The paper
20 was based on a field survey that Reinaldo Jenkins
21 headed. We went through 17 -- or Reinaldo went to 17
22 rate control centers and 17 nuclear powerplants, and
23 just the basic -- and took a basic overview of what
24 was going on or what the people had planned to do for
25 deregulation.

1 It was also based on -- we made multiple
2 trips to the California ISO and PJM, and not because
3 they were problems but because they were on the
4 leading edge so to speak of what was going on on
5 deregulation and were fairly open and willing to share
6 with us what they've done. And it was also based on
7 NERC reliability forecast. NERC does a -- annually
8 they do a 10-year forecast, and we made extensive use
9 of that, and then we also used the operating
10 experience.

11 And what we've tried to do from all of
12 that was postulate what could happen, and, you know,
13 our things we were concerned -- well, I'll get into
14 that later. But one of the recommendations in
15 response to the Commission's question, "What action
16 should we take to maintain the licensing basis?" was
17 that we would monitor and assess the grid impact and
18 nuclear plant performance, and ergo this study was
19 planned. And John talked about the timing of the
20 study.

21 The next step is we're planning to issue
22 a NUREG in November. We've got comments from the --
23 stakeholder comments from the May issue of the report.
24 We're revising -- there were some minor revisions to
25 the report to address those that we'll talk about.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 Along the way, too -- I didn't put it on
2 here -- is that NRR issued two INs and a RIS having to
3 do with deregulation, just alerting the industry to
4 their concerns. INPO has taken some steps. They've
5 been out kicking the tires, trying to make sure that
6 the plants have been prepared for deregulation, as the
7 follow-on to some of NRR's INs and RISS.

8 Now I'll come back to the methodology and
9 the report a little ways up.

10 In regulatory space, we're talking about
11 GDC-17 having to do with the capacity and capability
12 of the offsite power system, and, in particular,
13 minimizing the chance that a loop -- that a reactor
14 trip will cause a loop.

15 What's important to recognize in
16 determining the system capacity and capability -- I
17 think what's important to recognize about the grid is
18 you can't test the capability of the grid, so you have
19 to analyze it. And you have to be prepared for
20 contingencies that you would expect. Typically, the
21 utility is designed for a -- so that the grid will
22 remain stable for a reactor trip or a single, and
23 even, in some cases, double contingencies.

24 So what they try to do is bounding
25 analysis. Before deregulation, each utility had a

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 finite area to manage, and you had a finite number of
2 configurations and the analysis. So you could do --
3 typically on an annual basis, they did power flows,
4 voltage profile, stability analysis, and based on
5 those revised their operating procedures and got the
6 grid set up for successful operation.

7 What the station blackout rule identified
8 is the risk factors, the important risk factors, the
9 loop frequency and duration, and the diesel --
10 emergency diesel generator redundancy and reliability.
11 And the outcome of that was coping times, and most
12 plants subscribe to a four- or eight-hour coping time
13 as a result of that.

14 In the maintenance rule, we pay attention
15 to A4, where licensees are required to manage the
16 increase in risk from plant activities, such as
17 testing the diesel. And there are subjects that are
18 relevant to what we're going to be -- what we looked
19 at.

20 As far as deregulation, there's two
21 aspects that we focused on. One was the 1992 National
22 Energy Policy Act, and that encouraged open generator
23 transmission or open generator access to the
24 transmission system and statutory reforms at the state
25 level to promote wholesale generators.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 The concerns that result from that with
2 the states, when they deregulated they busted up the
3 traditional utility into a generating company and
4 transmission company, and you introduced more players.
5 So our logic was that with more players you'd have
6 longer recovery times, just more coordination, more
7 parties to coordinate.

8 And I think a good example of that is
9 Calloway had an event in '99, and they -- the reactor
10 tripped, and shortly thereafter the voltage dropped
11 because of the grid. There was a transmission line --
12 nearby transmission line congestion. The reactor trip
13 exacerbated that.

14 In order to recover, it took 12 hours to
15 rearrange, but then the power flows were coming from
16 Canada down to Texas for cold weather where they had
17 lots of generation down to the hot weather. And it
18 took 12 hours to rearrange the grid, to reestablish
19 the proper voltages at Calloway.

20 The next bullet has to do with FERC
21 Order 888, and that required all utilities to provide
22 for open access generation to the transmission system.
23 What that means is anybody could buy a lot, build a
24 generator, and they'd gain access to the transmission
25 system.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 In my report, I make reference to a slide
2 on a DOE website that shows the status of
3 deregulation. This was as of -- this is -- I took
4 this off their website yesterday, but shows up in --
5 Region 1 basically is fully deregulated. Region 3 is
6 about 50/50. And then -- and it's mixed out in
7 Region 4, and nothing going on in Region 2.

8 But it's important to remember that even
9 though a state hasn't restructured, all states are
10 subject to open access transmission. So that's an
11 important part of this. Just because you haven't --
12 your state hasn't deregulated, so to speak, doesn't
13 mean you're exempt from the consequences of
14 deregulation.

15 And then I want to talk a little about the
16 report that -- the information in the report that is
17 -- just downloaded information in the report I didn't
18 put in the slides. These are really backup slides.

19 But the overall objective of our report
20 was to see if there was any change in the deregulated
21 environment. And the method we used is -- what I did
22 is I drew a line of demarcation between the site and
23 the grid, and the line of demarcation was across the
24 high voltage terminals of the transformers.

25 And the plant side I called the plant, and

1 the grid side was -- there was the grid, and then we
2 busted the grid up into the switchyard and the
3 transmission system. And then we began classification
4 of events. According to R events --

5 MEMBER LEITCH: Just to be clear, the main
6 transformer was with the powerplant.

7 MR. RAUGHLEY: Yes. The main transformer
8 is with the powerplant, and the station transformers
9 were with the powerplant.

10 MEMBER ROSEN: Just line it up, so --

11 MR. RAUGHLEY: Okay. Sorry.

12 MEMBER ROSEN: Now let's be a little more
13 specific. The main transformer, high side, is with
14 the powerplant or with the grid?

15 MR. RAUGHLEY: With the powerplant. The
16 transformer is with the powerplant, and the station
17 transformers, which connect to the offsite system,
18 were with the plant. The generator breakers and all
19 of the high voltage equipment was with the grid. And
20 I called that -- that was part of the switchyard. And
21 then, out beyond the switchyard I called the
22 transmission system.

23 MEMBER ROSEN: Okay.

24 MR. RAUGHLEY: So then what we did is then
25 we looked at -- and then we were just looking at

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 reactor trips from power. We didn't look at anything
2 from zero to power. So this is all reactor trips from
3 power.

4 Then, we had R events, which are the
5 GDC-17 events, and in particular these were loops,
6 partial loops, or voltage degradations below the tech
7 spec limit. And what we were looking for there is
8 that subset of events where the reactor trip caused a
9 consequential loop.

10 When the reactor trips, you're depleting
11 a certain amount of watts and bars from the system.
12 And if the system doesn't have enough reserve to
13 recover, you -- you're going to get a voltage drop.
14 If there's not enough reserve to recover, the voltage
15 will stay depressed and you'll experience a loop.

16 And then, let me jump down to the elements
17 or the traditional loops where the first sequence of
18 events was in the switchyard or the transmission
19 system. R and L events were part of the risk analysis
20 we did. The S and T events -- well, the R and L
21 events are all -- they're all loops and part of the
22 risk analysis. The S and T events are generally not
23 risk-significant, and what we used those for was to
24 get insights.

25 And the S events were reactor trips for

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 the first sequence of events -- were in the
2 switchyard, and the T events were reactor trips for
3 the first event in the sequence of events -- was in
4 the transmission system.

5 And we devoted a page in the report to say
6 -- to point out that this is very different from what
7 we have done in the past. Before the R and the L
8 events, there wasn't any distinction there, just a
9 loop was a loop. And the S and T events were
10 traditionally called turbine trips.

11 So, and all of these have -- you know,
12 there's -- these are events where there's -- a lot of
13 the events I looked at were traditionally plant-
14 centered events. And what we're doing is looking at
15 the grid aspects of these events, so there's both
16 plant and grid aspects to these events. But the grid
17 did play a major part in the event.

18 MEMBER LEITCH: In the S and T events,
19 though, although they might be referred to as turbine
20 trips, the initial event is, I would think, a
21 generator breaker opening.

22 MR. RAUGHLEY: Yes. Yes. An example
23 would be there's one event in there where a fault in
24 North Carolina tripped the circ water pumps at North
25 Anna. You know, and that reduced vacuum and led to a

1 reactor trip, and traditionally we call that -- I
2 mean, led to a turbine trip. But really, the first
3 event in the sequence was the fault in North Carolina.

4 MEMBER LEITCH: Yes.

5 MR. RAUGHLEY: It caused negative phase
6 sequence, current imbalances, and it led to --

7 MEMBER ROSEN: And this cropduster into
8 the Wolf Creek transmission line is a T event.

9 MR. RAUGHLEY: Yes.

10 MEMBER LEITCH: Now, you say the S and T
11 events are not risk-significant? Did I hear --

12 MR. RAUGHLEY: No, just a straightforward
13 reactor trip is usually a low 10^{-6} .

14 MEMBER LEITCH: Yes, a reactor trip. But
15 you don't differentiate between that and a generator
16 breaker opening?

17 MR. RAUGHLEY: It depends why the
18 generator breaker opened. If the generator breaker
19 opened because of a generator fault, then that would
20 be a plant-centered event and I didn't count that
21 there. If the generator breaker opened because of a
22 transmission line fault, or a fault in the switchyard,
23 or a plane flew into the transmission lines, then that
24 would be S and T events.

25 MEMBER LEITCH: But from a risk

1 standpoint, I would think a generator breaker opening
2 at full power would be more risk significant than a
3 reactor trip.

4 MR. RAUGHLEY: No. They're all around
5 very low 10^{-6} -ish.

6 MEMBER LEITCH: Okay.

7 MEMBER ROSEN: Well, it might be more
8 significant -- the damage to the plant. The turbine
9 doesn't necessarily react to core damage frequency.

10 MEMBER LEITCH: Yes. You'd have to
11 postulate a turbine runaway, creating a missile, which
12 now, you know, it's a -- I can understand why it's --

13 MEMBER ROSEN: Why there's very low
14 probability.

15 MEMBER LEITCH: Yes, yes.

16 MR. RAUGHLEY: Collectively, Jerry is
17 going to talk about the numbers of S and T events. He
18 took what I did and carried it through to 2002, 2003,
19 and there are some fine nuances. But just so there's
20 no confusion, we'll let him show you the number-
21 crunching he did on there. It's very revealing.

22 I will say that the -- in the S and T
23 events, I did a writeup in there on two events. Well,
24 one, I pointed out that there were four multi-unit
25 trips, and we -- Section -- I think it's 3.3.3 in the

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 revised report and in the old report talks about two
2 events in California.

3 One tripped -- it was a grid event that
4 tripped two units in one case and four units in
5 another. It tripped two units at Diablo with a four-
6 unit trip and two units at Palo Verde. And they were
7 a cornerstone of the California ISO. They had
8 analyzed those events to death, but they shaped a lot
9 of what the California ISO did.

10 An example is, as a result of that, they
11 increased their reliability criteria to require that
12 the grid be able to sustain the loss of all generators
13 connected to a common switchyard. Typically, you'd
14 only want one, but that's what the California ISO
15 determined you would need to do to survive an event
16 like that. And, importantly, there was a NERC report
17 that identified 65 corrective actions.

18 And then, on the R events, the things I
19 want to point out -- that up to the time of the trip
20 the plants were operable. Eight of those 10 events
21 took place in the summer. Seven of the 10 were in the
22 northeast.

23 And I think there's -- or there are
24 partial loops and tech spec voltage degradations there
25 that normally we ignore. But if you look at those,

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 they are indicating weaknesses in the grid. I mean,
2 if a unit trip causes a partial loop, it's indicating
3 a potential weakness in the grid.

4 And as far as other features of the study,
5 it's all based on actual data. I've only made two
6 assumptions where we don't have data for what's the
7 probability of recovering from the loss of all
8 diesels. We have no experience in that area, and we
9 have no experience from recovering from the loss of
10 all -- the failure to recover from the loss of all
11 diesels in four hours. So we make two assumptions
12 there.

13 And the internal comment there is that I
14 was conservatively low on those assumptions. So if
15 anything, the risk that we came up with might be a
16 little higher.

17 Another comment on the data that we got
18 was whether there was enough data, and it was
19 suggested that I look at what EPRI did when they
20 analyzed loop events. And they take a short-term look
21 at five years, and it's exactly what I did. I also
22 had two of our statisticians look at our data.

23 There was questions about, did we have
24 enough data? And, really, we're in the lower part of
25 the statistical interval. So, again, it's non-

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 conservative, you know, and there's risk and we're
2 non-conservative.

3 So the things we talk about in the report
4 on what has changed is -- is that there were some
5 events -- the Calloway event and one of the reactor
6 trips -- where there was a consequential loop. It
7 involved increased transmission line loading. And as
8 a result of deregulation, you have -- the open
9 generator access causes changes in the power flow.

10 The power flows according to the laws of
11 electricity -- Kirkoff's laws. And if you overload a
12 transmission, a nearby transmission line to a voltage
13 plant, what you're effectively doing is increasing the
14 impedance hanging on the terminals of the plant. And
15 that's causing an additional voltage drop, and that's
16 exactly what happened at Calloway and in an event at
17 Oyster Creek.

18 The other thing we talk about there are
19 lower grid reactive capabilities. We looked at a PJM
20 event. There weren't any loops, but it involved the
21 PJM system, 12 nuclear powerplants. It was two hot
22 days in July, two separate events.

23 And as they began to -- you know, as the
24 load rose, they went through their voltage reduction
25 and all of their procedures to maintain the system in

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 the condition they wanted. But as they went through
2 this, the grid started -- didn't respond to what they
3 expected. And they got to the end of their procedures
4 and the voltage was still high.

5 In the followup, what they found was 54 of
6 the 72 generators that they were expecting to provide
7 -- that didn't provide the advertised reactive
8 capability.

9 The other thing we pointed out was that
10 the reactor power uprates -- a generator, as a
11 constant KVA device, if you increase the power, you
12 decrease the MVA. The generator is -- let me get a
13 backup slide to -- I saw some strange looks.

14 This is a typical generator reactive
15 capability curve. Typically, you're rated at .95, and
16 you would be about at a -- you know, .92, .94 per unit
17 power. So if you come up here and increase the power
18 rating, you are on a fairly steep part of the curve.
19 You decrease the reactive capability.

20 And one generator -- one power uprate at
21 a time is -- it doesn't make a difference. I think in
22 the report I pointed out there have been 62 power
23 uprates, and it has depleted approximately 4,000
24 megavars in total from the grid. That's significant.

25 In NERC's comments to our report they

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 pointed out that that was significant, and they
2 indicated to us that those bars should be replaced.
3 But they -- and I think they were going to pursue
4 that.

5 MEMBER SIEBER: Well, the amount of
6 reactive that's flowing around the grid is
7 controllable by changing the excitation voltage on --

8 MR. RAUGHLEY: Yes.

9 MEMBER SIEBER: And so typically that's
10 what happens. The problem is that you may end up with
11 a unit here and there that's doing a lot of reactor
12 duty and not generating much real power.

13 MR. RAUGHLEY: That's true.

14 MEMBER SIEBER: And so you've got current
15 going like crazy, but no megawatts.

16 MR. RAUGHLEY: Yes. There's a tradeoff
17 there.

18 MEMBER SIEBER: Because what makes it flow
19 is the difference in phase angles from one end to the
20 other, right?

21 MR. RAUGHLEY: Yes, on the power.
22 There's --

23 MEMBER SIEBER: Well, the power is voltage
24 that --

25 MR. RAUGHLEY: Well, both are voltage. If

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 you -- you had mentioned this to me before. I just
2 made this up. He had mentioned it to me at the
3 meeting -- our meeting -- before we started the
4 meeting.

5 If you look at it simplistically, a
6 generator and a load and the reactants between them,
7 the power flow is a function of the voltage, the sign
8 of the angle between them -- and I'll explain what
9 that is -- and the reactants between them.

10 And if you were to take the motor and the
11 generator at stand-still and take a marker and mark a
12 stationary mark on the shaft on the stationary part of
13 the machine, and do the same thing on the motor, as
14 you load the generator you -- and put a strobe light
15 on it you'd see this -- the generator.

16 It's like the timing light, for those of
17 you that remember. points on cars. You see the
18 generator would move this way, in the direction of the
19 rotation of the machine, and the motor would move this
20 way. That's the angle they were talking about.

21 But for constant power, then the voltage
22 is going to drop. So that's why you have an automatic
23 volt. That's why it's important to have the voltage
24 regulator in auto all the time. Then that
25 automatically increases the voltage.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MEMBER SIEBER: Another way to look at it
2 is if the motor is sitting there with no load, but
3 turning and you start putting a mechanical load on the
4 motor, that angle changes between the motor phase and
5 the generator phase.

6 MR. RAUGHLEY: Yes.

7 MEMBER SIEBER: And the voltage regulator
8 reduced the voltage, and the turbine throttle valves
9 open up.

10 MR. RAUGHLEY: Yes. This is called the
11 stability limit.

12 MEMBER SIEBER: Yes.

13 MR. RAUGHLEY: Just for your information.
14 And this is the basic equation to all stability
15 analysis.

16 MEMBER LEITCH: So a lot of these plants
17 that didn't respond in the 1999 PJM episode probably
18 had their voltage regulators on manual.

19 MR. RAUGHLEY: It was more a function of
20 the fact that it was so hot that it derated the
21 machine, and it couldn't deliver --

22 MEMBER LEITCH: Okay. So it was --

23 MR. RAUGHLEY: -- the rated power. And
24 the cumulative effect of that --

25 MEMBER SIEBER: In the network, the

1 machine that's dealing with reactor power looks more
2 like a capacitor than an inductor, or it can.

3 MR. RAUGHLEY: Yes. The next bullet we
4 add this. NERC pointed out to us -- let me back up.
5 Both of these things lead to lower voltages. You
6 know, lower voltages may require different action
7 levels.

8 The next bullet -- increase in the
9 transmission line relief requests -- when NERC read
10 our report they called right away and said, "Go to our
11 website and click here, there, and the other thing,
12 and look at this curve." And this is transmission
13 line relief requests.

14 What they are are LERs basically on the
15 system, and they're graded one through six. And about
16 LER 3 require physical actions in terms of curtailing
17 transactions, reconfiguring the grid, and then you get
18 into levels 5 and 6 and they require actions within 10
19 minutes and five minutes, respectively.

20 And what you have here is here's '97, and
21 some -- where you have -- where deregulation -- that's
22 when open generator access transmission started. Then
23 you have '98 and '99, 2000, 2001, 2002. So you can
24 see the level of activity increasing.

25 And the reason NERC pointed out to us --

1 one of our conclusions was that that -- that the
2 concern should be from May to September, and that's
3 what triggered this, May to September.

4 MEMBER LEITCH: That's certainly the
5 bigger concern. But even in the winter months, there
6 is a significant increase in the number of relief
7 requests. I mean, you were running along here at
8 whatever that is -- 10.

9 MR. RAUGHLEY: Yes, per month.

10 MEMBER LEITCH: And then more recent --

11 MR. RAUGHLEY: Numbers per month.

12 MEMBER LEITCH: Yes. And more recent it
13 looks like 60, 70, even in the winter months.

14 MR. RAUGHLEY: But, again, it's something
15 that supports things that have changed.

16 MEMBER LEITCH: It's certainly a lot worse
17 in the summer.

18 MEMBER SIEBER: Well, let me ask a
19 question which will be an opinion, and maybe you don't
20 know and can't answer. But it looks like grid
21 capacity has remained the same, while load is going
22 up.

23 MR. RAUGHLEY: Yes.

24 MEMBER SIEBER: And that's due to a lack
25 of investment in the transmission systems?

1 MR. RAUGHLEY: Yes. There is -- John
2 mentioned we were briefing -- Reinaldo and I and Mr.
3 Calvo briefed Commissioner Merrifield on the day of
4 the event. And one of the things we took to the
5 meeting was a writeup from the New York ISO, and we
6 showed them curves in there.

7 What you said was exactly in there. It
8 showed the -- that that load was increasing,
9 generation had increased, and that the load had
10 intersected supply, and it showed -- and it had a
11 curve for transmission line investment going -- headed
12 down.

13 MEMBER SIEBER: And so the reason why the
14 physical situation exists is because the regulatory --
15 economic regulatory system wanted deregulation. And
16 to my mind, that would mean that the states involved
17 would be the states where economic deregulation
18 occurred, which would be our Region 1 and parts of
19 Region 4.

20 MR. RAUGHLEY: Yes. Yes. Our --

21 MEMBER SIEBER: That makes sense.

22 MR. RAUGHLEY: Yes. I mentioned the --

23 MEMBER SIEBER: If you go back to that map
24 of the United States, that's the way it looked.

25 MR. RAUGHLEY: Yes.

1 MEMBER ROSEN: Well, I guess I'll follow-
2 up that question. If you put that chart back up, the
3 one with the hump in it in the summertime, the number
4 of relief requests, if you split that up by region
5 you'd see no change in Regions 2 and 3, or very
6 little?

7 MR. RAUGHLEY: I didn't look at --

8 MEMBER ROSEN: And a big change in
9 Regions 1 and 4?

10 MR. RAUGHLEY: -- look at that.

11 MEMBER SIEBER: That would be interesting
12 to do, then, Steve.

13 MEMBER ROSEN: You didn't do that, you
14 say?

15 MEMBER SIEBER: No. But it would be
16 interesting to see that.

17 MR. RAUGHLEY: Yes. All of these
18 transmission line requests are written in terms of the
19 340 KV line from this town to this town. So you'd
20 have to have a grid of -- you know, a map of the grid
21 and go through and do that. But we could talk to NERC
22 about --

23 MEMBER SIEBER: Doing it.

24 MR. RAUGHLEY: I'm sure they've got some
25 database that would --

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MEMBER ROSEN: Do you have any sense of
2 where it's the highest?

3 MR. RAUGHLEY: I think it was in the
4 midwest.

5 MEMBER ROSEN: Really.

6 MR. RAUGHLEY: As in Ohio, Indiana,
7 Illinois.

8 MEMBER ROSEN: That's of some interest,
9 actually.

10 MEMBER SIEBER: Well, Illinois is
11 deregulated, but Indiana is not. And Ohio is not.

12 MR. RAUGHLEY: But you've got to remember,
13 the open generator access transmission doesn't --
14 there's two things going on here that --

15 MEMBER SIEBER: Well, even if we figured
16 out what the problem was, there wouldn't be anything
17 the NRC could do about it.

18 MR. RAUGHLEY: That's true. But we'll get
19 into one thing that some utilities have done about it
20 in one of our conclusions.

21 And the last has to do with the increased
22 coordination times, and the increased time -- there's
23 increased coordination times, and there's -- like I
24 said, the Calloway event that I mentioned. Both the
25 loops and events not involving a loop where you lose

1 power, the times are all increased.

2 And I've got another thought on this. As
3 far as the safety issues that come from this, what we
4 did on this is if you look at -- you know, I said we
5 compared before deregulation to after, I think. You
6 know, we started in '97, because that was their first
7 full year of open generator access transmission.

8 And looking through the before and the
9 after, you really don't see any change if you just
10 look at the data or average the data out over a full
11 year. But what we noticed when we put the data on a
12 spreadsheet was that all of the loops -- all but one
13 of the loops was in the summer.

14 And if you looked at that in the past,
15 they were evenly distributed throughout the year.
16 There were 54 loops I think, and the past 23 were in
17 the summer. And the rest were in the rest of the
18 year, and now we're looking at nine out of 10.

19 And it's the same on the risk. If you
20 look at the risk over the whole year, the risk drops.
21 As you start to look at it in the summer, the risk --
22 you start to see the change. So you don't see the
23 problem unless you look at it in the summer.

24 And then you have the increased likelihood
25 of an induced loop during the summer. Both the two

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 events in 2000 -- 201 trips -- is what we had there.

2 And the long time to recover from a loop
3 -- and there's a couple things going on there. You
4 have the increased coordination time. But if you look
5 at the loops, there's a noticeable absence. There are
6 no short plant-centered loops. If you look at the
7 data before, in the '85 to '96 timeframe, you see a
8 lot of one-minute, four-minute, 10-minute, quick,
9 quick loops. There are no short duration plant-
10 centered loops. All of the loops have to deal with --
11 there's one plant-centered loop. The rest of them
12 have to deal with either the grid or weather affecting
13 the grid.

14 As you can see, there is some -- and like
15 I said, all of these have plant aspects to them, but
16 these are the grid aspects.

17 The other thing -- we looked at the actual
18 recovery time and then the assumed availability. In
19 some of the risk analysis, they assume they could have
20 gotten power back sooner. But really it only makes it
21 -- our concern was for the events more than four
22 hours. It makes a difference of this column. It's --
23 66 percent of the events in the risk analysis were
24 more than four hours. And here it's 50 percent, and
25 it really doesn't make much difference to the risk.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MEMBER LEITCH: I would assume some of the
2 problem is not only communication time but also
3 restoration procedures. These are so complex it may
4 be difficult to have discreet restoration procedures.

5 When you were dealing with a traditional
6 utility that ran the generation and the transmission
7 system in its franchised area, there were pretty
8 specific procedures on how to restore the system. You
9 know, you cut away from your neighbors and you get
10 your hydro plants running, and you throw a feed to
11 your powerplants, and, you know, get yourself pretty
12 well bootstrapped. And now it's a much more complex
13 evolution, it would seem to me. And also, there are
14 so many variables it's difficult to have a discreet
15 procedure.

16 MR. RAUGHLEY: Yes, it's definitely plant-
17 specific, operator-dependent. You know, you're going
18 to get a wide range of responses. But you can see the
19 shortest event here is 90 minutes. If you use -- if
20 you count the actual time, it's 43 minutes. Where if
21 you look at the data before there is -- most of it is
22 on the average of 20 minutes, and all of those are
23 gone.

24 And again, procedure-wise, with the plant-
25 centered events you've got full control of the

1 recovery. You know, when you have an event on the
2 grid, then you've got to get other people on the
3 phone. In the appendix, I went through event 69 in
4 our report. It was a lightning strike, knocked out
5 one line. They had a partial loop. They hastened to
6 recover. It progressed to a loop.

7 They forgot to reset a relay, so they
8 opened up five more breakers on this end and five more
9 on that end, progressed to a loop, and then they had
10 to get the proper person in to tell them how to get it
11 back. They had to walk it down. They had to do some
12 minor testing. That took a total of eight hours.
13 That's --

14 MEMBER ROSEN: You've kind of explained
15 why events have gotten longer. But why did the ones
16 that were short go away?

17 MR. RAUGHLEY: They're under the plant's
18 control. The plants have -- I would attribute it to
19 strong corrective action programs in the plant. If
20 the plant aggressively -- my experience has been
21 plants aggressively pursue reductions in reactor trips
22 that they have control over.

23 This is a large family of reactor trips
24 that they have no -- they have no control over the
25 weather, or, you know, any changes you have to make to

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 the switchyard or the transmission system. I think
2 things under their control, that's on their radar
3 screen, they go after it.

4 I think the carrot for the industry here
5 is in the S and T, you know, all of these -- we're
6 talking 50, 60 grid-related reactor trips. And
7 collectively, in a deregulated environment, you're
8 looking at -- if you're out two days, you're looking
9 at a couple million dollars a trip times 50 is
10 100 million.

11 And if you reduce -- overall, if you
12 reduce 50 reactor trips, you know, it's probably eight
13 or nine percent reduction in the overall risk from
14 nuclear power. That's how they have to look at this.
15 That's the carrot to get with the transmission and
16 switchyard people along here.

17 Our conclusions had to deal with you need
18 to consider the seasonal effects, particularly when
19 you're doing EDG maintenance. There you don't want to
20 do the EDG maintenance and have the diesel on the
21 floor when the grid is degraded. And likewise with
22 the maintenance.

23 Some utilities we think, particularly the
24 California ISO, there is contractual arrangements
25 between the grid operators and the nuclear

1 powerplants. And what they've done in California is
2 all of the communication protocols, the design inputs,
3 the design outputs, are all part of a contracted part
4 of the technical specification.

5 So, for example, San Onofre has a very
6 detailed contract, and they said, "You've told me your
7 grid will behave like this." They've done their
8 analysis, and they've gone back and said, "We need
9 this much bars and watts as a function of time for
10 this condition. We need power back in four hours if
11 we go black," and as a result there's a black --
12 there's a market for black start -- basically, for an
13 alternate access generator. But everything is in the
14 form of a contract where there's a hard agreement
15 between the transmission company and the switchyard.

16 And our last thing is you have to do -- to
17 consider real-time parameters. With this open
18 generator access, the stuff is changing daily.
19 California they do -- what we used to do a public
20 service once a year, they do once per shift. They
21 have a team of 40 electrical engineers split over
22 three shifts doing low flows, voltage drops, stability
23 analysis, to make sure they're never in a non-analyzed
24 condition.

25 MEMBER SHACK: Now, when they had their

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 contracts, were they maintained during the brownouts?

2 MR. RAUGHLEY: Yes, I would attribute that
3 that was the actions they had set up with all of the
4 shenanigans going on with the -- you know, they were
5 the ones directing the brownouts, to maintain the grid
6 in a stable condition.

7 MEMBER SIEBER: But the actual purchase
8 and scheduling of power was outside those contracts,
9 right?

10 MR. RAUGHLEY: Yes. The actual purchasing
11 and scheduling of power is done on a daily basis.
12 They have a power market that opens at midnight and
13 closes at 7:00 in the morning for the next day. The
14 engineers go through by 1:00. They reanalyze the grid
15 for the results of the power market, and then between
16 1:00 and 4:00 they direct the -- redirect the bidding
17 in the power market.

18 MEMBER SIEBER: Let me ask you this
19 question to help refresh myself on the way this really
20 works. If Company A decides to sell to Company B
21 10 hours worth of electricity at 1,000 megawatts an
22 hour, they will schedule that on some transmission
23 line. The fact is that it won't necessarily go on
24 that transmission line.

25 MR. RAUGHLEY: Exactly.

1 MEMBER SIEBER: But it'll go on somebody
2 else's system maybe. And you can't schedule the bars,
3 because you really don't know what the bars are going
4 to be unless you have real-time --

5 MR. RAUGHLEY: Right.

6 MEMBER SIEBER: -- flows. Okay. And so
7 how do you manage -- since everything has a limit, how
8 do you manage where everything is going? I mean, I
9 can see how you make your money --

10 MR. RAUGHLEY: You have to do the analysis
11 and make sure you're in an analyzed condition.

12 MEMBER SIEBER: You'd have to do the
13 analysis just to make sure that the power even went.

14 MR. RAUGHLEY: Yes. You've got to do the
15 analysis to figure out where it's going to go.

16 MEMBER SIEBER: Yes, right.

17 MR. RAUGHLEY: And you can ship power from
18 Virginia to Massachusetts, and it could go up around
19 the Great Lakes and over. I mean, it's --

20 MEMBER SIEBER: In the old system, you
21 used to be able to control the ins and outs on your
22 transmission lines by adjusting all of the exciter
23 voltages.

24 MR. RAUGHLEY: The exciter voltage -- and
25 there's signals on -- there were signals on the inner

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 ties to bias --

2 MEMBER SIEBER: Yes, the power --

3 MR. RAUGHLEY: -- the governor responses.

4 MEMBER SIEBER: Right. Yes, you would
5 dial in a certain resistance.

6 MR. RAUGHLEY: Yes.

7 MEMBER SIEBER: But that's gone now?

8 MR. RAUGHLEY: I haven't followed up on
9 that. I don't know for sure. I would suspect it has
10 to be for what they're doing.

11 MEMBER SIEBER: I would think so.

12 MEMBER ROSEN: Who do these 40 engineers
13 work for? Do they --

14 MR. RAUGHLEY: They work for the
15 California ISO. They basically manage everything from
16 Idaho down and over. They're looking at that part of
17 the grid -- Washington, Oregon, California, Arizona,
18 New Mexico, and back up. It's a nonprofit
19 organization and participating transmission companies
20 pay them to manage the grid.

21 MEMBER SIEBER: So getting back to my line
22 of thought, you would probably have to have at least
23 20 percent excess capacity over your expected peak
24 load in order to be able to handle the variety of
25 routes that the transmissions could occur on.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MR. RAUGHLEY: Yes, it would vary from
2 system to system. I don't --

3 MEMBER SIEBER: But quite frequently, west
4 to east power goes through Canada, right? From the
5 midwest to the east coast.

6 MR. RAUGHLEY: Yes. What you're trying to
7 do is the power is more expensive on the --

8 MEMBER SIEBER: Right.

9 MR. RAUGHLEY: -- northeast. So, and it's
10 cheap in the south, so you'd like to sell it up in the
11 northeast and make more money.

12 MEMBER SIEBER: But you may end up with it
13 going through Canada to get there.

14 MR. RAUGHLEY: Yes.

15 VICE CHAIRMAN WALLIS: How much does it
16 lose on the way? If it goes 3,000 miles, I think it
17 loses -- the transmission losses must be significant.

18 MEMBER LEITCH: With the extremely high
19 voltages it's not much.

20 VICE CHAIRMAN WALLIS: But even so.

21 MEMBER SIEBER: It's still thousands of
22 amps.

23 MR. RAUGHLEY: Okay. As far as we issued
24 the report in May, and we also -- at that time, we
25 asked for stakeholder comment. We got comments from

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 Westinghouse, NEI, and NERC. These are the positive
2 comments. NERC and Westinghouse were very supportive
3 of the report. I think John read NERC's bottom line.
4 NEI looked at it statistically, and they just flat out
5 didn't like it.

6 And what we've done is we've taken the
7 comments and they've become -- they'll be put in
8 Appendix D of the revised report, and then we'll
9 address each comment. And that will be part of the
10 NUREG, so it's all together there as a package.

11 So the finale here -- changes in grid
12 performance have occurred since operating in a
13 deregulated environment. That performance can impact
14 the nuclear powerplants, and we need to continue to
15 seek a better understanding of the grid. And that's
16 what the -- and all of this is getting pumped into
17 Cornie's team.

18 MEMBER LEITCH: You intend to publish a
19 NUREG?

20 MR. RAUGHLEY: Yes, it's scheduled for
21 November.

22 MEMBER LEITCH: And it would -- that will
23 communicate your thoughts and recommendations to the
24 industry?

25 MR. RAUGHLEY: John will --

1 MR. FLACK: Yes. I think a lot of those
2 recommendations we see coming out of the study are
3 actually being picked up right now as part of the work
4 that's going on with the team. So this is -- Bill is
5 on the team itself, so we have a direct transfer of
6 that information to that team.

7 We also put the report on the web for
8 access for people to look at. And then, I don't know
9 if Cornie wants to take it from there and talk about
10 the team's efforts and what other recommendations
11 might be coming out of that.

12 MR. HOLDEN: Yes. I think obviously we're
13 going to have to have public interface on where the
14 team comes out.

15 MEMBER LEITCH: We have no authority to
16 hire some of these things. These are suggestions,
17 recommendations, but --

18 MR. HOLDEN: Right. We have no regulatory
19 authority over the grid.

20 MEMBER ROSEN: But on the other hand, if
21 the staff concludes that a client is not meeting GDCs
22 because of this --

23 MEMBER LEITCH: Yes, then we have --

24 MEMBER ROSEN: -- then we have direct
25 authority on that licensee.

1 MEMBER LEITCH: Yes, we do.

2 MEMBER ROSEN: Which exercising that
3 regulatory authority could influence their views.

4 MEMBER LEITCH: Correct.

5 MR. FLACK: Another option might be a
6 policy of some sort where it specifies our
7 expectations as an agency. But that's being
8 entertained at this point. It's something to think
9 about.

10 MEMBER SIEBER: Before you disappear, the
11 slide you now have in your hand, could you give us
12 copies of that?

13 MR. RAUGHLEY: Sure.

14 MEMBER SIEBER: Okay. I have one other
15 question. On degraded grid, a lot of stations have
16 tap-changing auxiliary transformers. Are they typical
17 -- the typical ones they install in nuclear
18 powerplants? Can they change taps under load?

19 MR. RAUGHLEY: Yes. Some, not all,
20 probably a third.

21 MEMBER SIEBER: But they're not automatic.

22 MR. RAUGHLEY: A third are automatic, and
23 all the rest are no-load taps.

24 MEMBER SIEBER: Okay.

25 MR. RAUGHLEY: One thing that has come of

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 this, you know, after the Calloway event they replaced
2 their transformers with no-load taps with automatic --
3 bought new transformers.

4 MEMBER SIEBER: No-load taps.

5 MR. RAUGHLEY: And put in capacitor banks.
6 After the California events, Diablo Canyon replaced
7 all of their transformers with automatic tap changers.
8 And I think Salem has recently replaced theirs.

9 MEMBER SIEBER: They can -- the automatic
10 ones can change under load.

11 MR. RAUGHLEY: Yes.

12 MEMBER SIEBER: The no-load taps cannot,
13 and that's where you put capacitor banks with circuit
14 breakers, to put them in --

15 MR. RAUGHLEY: Yes. Some places like
16 Calloway needed both to get it to work right.

17 MEMBER SIEBER: Okay. And so that is
18 something the agency can regulate. You can force the
19 utility to deal with degraded grid situations where
20 you may have voltage and power available that is below
21 the level at which all of your under voltage relays
22 would actuate.

23 MEMBER LEITCH: Okay. Thank you, Bill.

24 I guess we'll ask Jerry to give his
25 presentation. Jerry, have at it.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MEMBER SIEBER: Thank you very much. Good
2 presentation.

3 MR. DOZIER: Good afternoon. My name is
4 Jerry Dozier. I'm in the Operating Experience
5 Section. The Operating Experience Section is a real-
6 time organization. We look at briefs -- at events
7 early in the morning. By 8:00, we brief these events
8 to the executive team. 8:30 we're in a meeting to
9 discuss the generic implications, and also followup of
10 the events. And then, we also participate with the
11 regions in the agency response, the special
12 inspections, augmented inspection teams, and things of
13 that nature.

14 And that's what really brought this
15 presentation to being is that the executive team asked
16 that, okay, we have the Riley report. Let's see
17 what's happening now with our grid. This was actually
18 put together before the task force was assembled, so
19 this was some of the early information, although I
20 have updated those graphs to reflect the information
21 to date.

22 The objective of this presentation is to
23 graphically present recent grid event data.
24 Hopefully, a graph is worth 1,000 words, and some of
25 the data will speak for itself. I will also be

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 talking about an overview of three recent events and
2 the different agency responses that we have for these
3 different events.

4 We have a -- you know, we all -- if we
5 have a grid event, we don't always respond to it the
6 same. And so I've got a few examples showing that
7 differentiation, and more of our risk-informed
8 approach to addressing these -- to responding to the
9 events.

10 As Bill said, in this particular
11 presentation I'm only dealing with the S, which is the
12 switchyard events. That's the 500 KV switchyard right
13 there outside of the plant. That's the S events. T
14 is those things within the -- outside of the
15 transmission grid that's outside of that area.

16 Now, an R event is -- those events are
17 those that we've had a reactor scram, and by having
18 the reactor scram we lost offsite power. A lot of
19 times what -- and there's only 10 of these events in
20 the period '94 to 2003. But if you look at some of
21 those events, basically what happened was we had the
22 scram, there was something wrong in the switchyard
23 area, and it gave us that loss of offsite power. So
24 that's what we're talking about -- the T, S, and R
25 events.

1 The first graph we have here, the pie
2 chart, this is the entire period 1994 to present. We
3 see here that basically about 50/50. We have 50
4 percent of our problems right there in that low area
5 right outside the plant. I'll show a switchyard a
6 little bit later and show -- and maybe that will show
7 -- demonstrate why, you know, with the multiple
8 redundancy we have in this a single failure on the
9 outside grid a lot of times doesn't have a real effect
10 on the -- in a lot of cases don't have a real effect
11 on the plant. And I'll show one of those.

12 Now, in the period -- if you take 2002 to
13 present, our new information after the Riley event,
14 you'll again see it's about a 50/50 type of situation.
15 In this case, there were zero R events.

16 The next graph presents the information.
17 The S, T, and R events from 1994 to present. There is
18 a couple of errors on this, and maybe if you ask about
19 the -- you know, there is a little bit of margin for
20 error in this, and I wanted to express it. There were
21 actually nine events that occurred as a result of the
22 blackout on 8/14. So reduce this number actually from
23 27 events to 25.

24 But all in all, if you look at 2003,
25 whether or not it's 25 or 27 events, these are 20-

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 something events that have caused actual reactor
2 scrams within our system.

3 If you take away the red line there
4 reflecting -- if you take away the blackout that
5 occurred, then really in the 2003 time period you're
6 looking back at '95, '96, you know, maybe even before
7 deregulation and now, may not have been so much
8 different, but Bill talked about, well, the duration
9 of those events had been longer. Maybe the earlier
10 events were shorter duration, loss of offsite power
11 for these later are longer in duration. So it's not
12 quite an apples for apples comparison.

13 CHAIRMAN BONACA: Yes. But even if you
14 take out those from the blackout, you still have a
15 higher number, don't you?

16 MR. DOZIER: Yes. It's a little bit
17 higher number, yes.

18 CHAIRMAN BONACA: And the year is not
19 over.

20 MR. DOZIER: Right.

21 CHAIRMAN BONACA: Okay.

22 MR. DOZIER: So the next question was:
23 why did we have these events in the first place? And
24 this pie chart, if you'll just focus on the three
25 biggest parts of the pie, you'll see one of the bigger

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 ones was equipment failure. And that one is kind of
2 self-explanatory. Something happened with the
3 equipment.

4 The next one was a fault occurred. Now
5 this is a lightning strike, salting of the switch
6 gear, things of that nature, raccoon running over the
7 line. Those are the fault types of situations.

8 The next biggest one is -- and this is a
9 '94 to 2003 period -- the next one is the weakness in
10 the electrical grid. Now that's the area that the
11 station blackout was in, and that's where you would
12 categorize those three events. So you see here a
13 large piece of that pie is attributed to those three
14 causes.

15 If you break it down into just the 2002 to
16 2003 period, you'll see that those three have grown --
17 the electrical, equipment failure, and fault. And so
18 that seems to be the 80 percent of the pie that is
19 causing the most problem.

20 The next graph and the next series of
21 graphs is the grid events by region. And Bill showed
22 that chart on deregulation in the different regions
23 that had regulation versus those that didn't. I
24 didn't make an attempt to correspond that data, but if
25 you look at this '94 to present data you'll see that

1 -- and then also right after the blackout everybody
2 was focused on Region 1 and a little bit of Region 3.

3 But if you look at this and you take the
4 whole period into consideration, you see that Region 4
5 popped up pretty good in this as far as numbers of
6 events that actually scrambled the plant.

7 The executive team asked a question. They
8 said, "Well, we've got different numbers of plants in
9 there, so I'd like you to normalize this data to see
10 what really happens." Region 2 in this -- the text
11 box up there under number of plants, you'll see that
12 Region 2 has a lot of plants with 32.

13 So, really, what happens with this
14 normalization is you get -- Region 2 gets worse as far
15 as -- I mean, gets better -- I'm sorry -- and Region 4
16 even gets worse when you normalize the data.

17 Now this is recent data. And actually, if
18 you look over here on the left this is only up to four
19 events. But it does show even that Region 4 had the
20 most number of these grid events prior to the
21 blackout. So I think the big thing is, you know,
22 Region 4 is kind of important, too, in these.

23 But after you consider the grid events and
24 put those into the equation, you'll see that Region 1
25 is the dominant winner on getting the bad piece of

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 this pie. Again, this is just a normalization of the
2 present data, and you'll see here that -- again,
3 Region 1 high with Regions 3 and 4 right there in the
4 -- about the same area.

5 Next I would like to share a few of the
6 events, go into a little bit of the details, but keep
7 it at an overview level. And the importance of this
8 event is it happened in April. This was prior to the
9 blackout occurring. And just to let the committee
10 know, we were already on a lot of these grid events.

11 For example, this grid event we had a
12 regional brief where we briefed all of the people --
13 the members of the region. But anyway, to describe
14 this event, basically though it was -- and this is the
15 big overview, and I'm going to go into a little bit of
16 the details. High winds in the 500 KV switchyard blew
17 a disconnect closed resulting in a partial loop.

18 I'll show you that disconnect in a few
19 minutes. It's basically just a -- well, I'll show it
20 in just a second.

21 MEMBER SIEBER: Well, they're gear-driven,
22 though, right? With a crank?

23 MR. DOZIER: Yes. It's manually -- you do
24 manually turn those.

25 MEMBER SIEBER: You turn the crank.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MR. DOZIER: Exactly.

2 MEMBER SIEBER: I don't see how the wind
3 could blow it closed.

4 MR. DOZIER: Well, it was -- I can go into
5 that just -- in the next picture, if I can --

6 MEMBER SIEBER: Fine.

7 MR. DOZIER: Okay. They scrambled on load
8 rejection. The diesel generators energized the safety
9 busses.

10 Now, what really throws these things into
11 higher risk is the plant response to the event. In
12 this case, the instrument air -- they had instrument
13 air complications. So that bumped the risk up a
14 little bit more, and that's really what -- one of the
15 factors that goes into making it a special --

16 MEMBER ROSEN: By "instrument air
17 complications," do you mean the instrument air
18 compressors were not on the safety bus?

19 MR. DOZIER: No. Instrument air is non-
20 safety-related.

21 MEMBER ROSEN: Yes.

22 MR. DOZIER: And in this case there was a
23 partial loop. They lost one of the service
24 transformers that fed the instrument air.

25 MEMBER ROSEN: Right. So the instrument

1 air compressors didn't have any power.

2 MR. DOZIER: Right. Right.

3 MEMBER ROSEN: That's what I was trying to
4 say.

5 MR. DOZIER: And it's not --

6 MEMBER ROSEN: The instrument air
7 compressors are not on the safety bus.

8 MR. DOZIER: Exactly. Exactly.

9 Okay. And I'll go a little bit into the
10 detail of this event now. This is the disconnect that
11 we're talking about. If you look here, basically this
12 disconnect -- if it was in the closed position, it
13 would come over and latch here. And that's the
14 energize position.

15 They were working on this breaker that was
16 over here. So this disconnect is in this risen
17 position. It's really designed for about 77 mile per
18 hour winds, but there was a problem with the
19 counterbalance on this particular one.

20 Now I'll go and show you. Since a lot of
21 these events -- really, if you kind of look at one,
22 you kind of get an idea of what goes on. But in this
23 case, the wind blew this disconnect closed. That was
24 the start of this event.

25 MEMBER SIEBER: So it must have broken

1 something in the disconnect.

2 MR. DOZIER: Yes. There was --

3 MEMBER SIEBER: A shaft or a pin or
4 something like that.

5 MR. DOZIER: There was a mechanical
6 problem with it, because it was designed for 77 mile
7 per hour winds. This was only 25 to 35 mile an hour
8 winds.

9 But, however, we're showing here it was
10 working on this particular date, 5204 breaker. And,
11 of course, this thunderstorm was coming up. The folks
12 that were working on it decided to take shelter in the
13 switchyard house. And at this point, the two
14 disconnects were in the open position.

15 Now, this switchyard is in the normal --
16 is showing the deenergized position. But, really, all
17 of these disconnects here are closed throughout this
18 system. I've talked about the redundancy of the
19 switchyard. For example, you have different lines.
20 You have a line coming from Baxter Wilson. That one
21 is independent from the Franklin line, and both of
22 these can feed this bus.

23 So there's a lot of redundancy in there,
24 and that's why a single failure of an outside power
25 source doesn't have so much effect on our plants.

1 What's not shown here, too, is there is
2 also a Fort Gibson line, a smaller 115 KV line that's
3 also into it. Notice here that I am talking about a
4 partial loss of offsite power, not a complete one.

5 MEMBER SIEBER: Was that disconnect the
6 clearance point for the safety corners for the break
7 repair? In other words, when it went closed, did it
8 energize the breaker that was being worked on?

9 MR. DOZIER: Exactly. Well, they didn't
10 energize that breaker. But what happened -- okay,
11 they had those disconnects open. The next thing is
12 these disconnects blow shut. So you've got a
13 grounding device right here, you know, to protect the
14 workers while they are working.

15 MEMBER SIEBER: So you can offset --

16 MR. DOZIER: Right. So when that
17 occurred, you basically caused a short here, which
18 made the -- a ground fault at this particular breaker
19 and this particular breaker. And that was your first
20 loss of this service transformer 21, which does go to
21 the division 2 and 3 safety busses.

22 MEMBER SIEBER: Right. Got it.

23 MR. DOZIER: After you had this fault
24 here, there was also some problems in the Baxter,
25 Wilson, and Franklin relay station. They temporarily

1 had a little perturbation there. That gave the -- a
2 differential current ground fault --

3 MEMBER SIEBER: Okay.

4 MR. DOZIER: -- for these areas. Your
5 generator was still coming in from this side over
6 here, but it was seeing so much of the different
7 perturbations it got a load reject.

8 MEMBER SIEBER: Okay.

9 MR. DOZIER: Load reject caused the
10 turbine control valves to go closed. Reactor
11 scrambled.

12 MEMBER SIEBER: Okay. Now, do those have
13 reclosers on them? Or do they just stay tripped? You
14 know, a recloser, once you get a fault, it will go and
15 try to connect it again.

16 MR. DOZIER: Actually, I'm not sure.

17 MEMBER SIEBER: Don't know. Okay.

18 MEMBER LEITCH: I think that's mainly at
19 lower voltages on the distribution system. I don't
20 think these 500 KV or 345, whatever it was, I don't
21 think they have reclosure devices on them.

22 MEMBER SIEBER: Okay.

23 MR. DOZIER: Okay. So we have an event
24 here. What did we do about it? The risk analysts
25 looked at it. This was in the E^{-6} to E^{-5} range. That

1 E⁻⁵ range came because of the -- like I said, we had
2 some instrument air complications, and so that's why
3 it shot up in that minus five area.

4 Now, that's the area where we look at
5 doing a special inspection. We look at the numbers.
6 We also have deterministic criteria that are also
7 looked at. You know, is there generic implications to
8 it? Was it a complex event? Was there a personnel
9 issue, performance issue involved? So that's the
10 deterministic criteria that we look at.

11 So in this case we went in with a special
12 inspection. As mentioned earlier, we did a briefing
13 to the regions on this event to explain and share the
14 lessons learned about the event. After the inspection
15 team went in, basically they did come out with a
16 finding on this instrument air, and it was a green
17 finding.

18 The next event -- this one just happened
19 the 19th of last month -- the Salem/Hope Creek. You
20 have Artificial Island kind of close to that -- you
21 know, the salt -- this estuary I think. And you had
22 high winds and rough surf during Hurricane Isabel.

23 We got salt deposits on that which caused
24 it -- caused a fault out in the switchyard. Hope
25 Creek got a reactor scram off that faulting situation.

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 Salem, on the other hand, they manually shut down.
2 Hope Creek -- they were a little more sensitive to
3 these faults because they had recently installed a
4 digital fault sensing system. But in this case, you
5 had -- this was one event where you have actually
6 three plants going down.

7 Okay. So what did we do with this event?
8 Well, in this case, it was in the 10^{-6} range. It was
9 right there in the special inspection area, but it was
10 felt like that we understood the salting, we
11 understood the hurricane and what happened. We kind
12 of looked at the licensee action, and then we said,
13 well, we're not going to do a special inspection for
14 this, because we can't really learn anything from it.
15 But we will follow-up as part of the routine baseline
16 inspection.

17 MEMBER ROSEN: How high were the winds at
18 Salem/Hope Creek?

19 MEMBER LEITCH: At Salem and Hope -- I
20 seem to remember around 75, but --

21 MEMBER ROSEN: So it was still a
22 hurricane, minimal hurricane.

23 MEMBER LEITCH: I didn't think it got to
24 quite hurricane strength, or they would have probably
25 manually shut the units down at that --

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MEMBER ROSEN: That's what I'm trying to
2 get at is how high were the winds, and what was their
3 hurricane shutdown procedure?

4 MEMBER LEITCH: Well, my impression was
5 that the winds in that area -- and I don't live too
6 far from there -- were probably about 40 miles an hour
7 with higher gusts.

8 MEMBER ROSEN: With the sustained wind,
9 the site never reached hurricane force.

10 MEMBER LEITCH: They say that -- they were
11 telling me that some of the problem was that they had
12 winds, but not a whole lot of rain. They said that if
13 they had some rain it would have helped this salting
14 situation. So they had the worst situation with the
15 wind blowing the saltwater onto the busses, without a
16 whole lot of rain to wash it off.

17 MR. DOZIER: And a lot of these plants
18 were in unusual events, which triggers at about I
19 think around 75 miles per hour winds.

20 MEMBER ROSEN: Well, 73 is hurricane,
21 minimal hurricane on the Saffir-Simpson Scale. And
22 plants usually have a different procedure once they
23 predict sustained winds greater than hurricane
24 strength. Sustained means for two hours or more
25 usually.

1 So, you know, I'm surprised that -- well,
2 I have to gather from this that they never predicted
3 sustained winds greater than 73 miles -- or never
4 experienced it. And, really, what they experienced
5 was gusts perhaps up there, and, like you say, no
6 rain, but enough wind to whip saltwater onto the
7 insulators.

8 MR. DOZIER: I think that's correct.

9 MEMBER LEITCH: I think had it been 75
10 they would have had to take action based on their
11 emergency procedures.

12 MEMBER ROSEN: If they predicted that the
13 winds would exceed 75 -- sustained winds in excess of
14 73 miles an hour, they would have had to shut down and
15 be in at least hot shutdown two hours before that
16 happened. I mean, that's typical.

17 MR. HOLDEN: I know that Region 1 spent a
18 couple of days before that hurricane reviewing the
19 hurricane response procedures at each licensee
20 facility that was anticipated. So they went up and
21 down the coast in Region 1 and Region 2.

22 MR. DOZIER: Okay. The next event which
23 Mr. Leitch had already talked about was Peach Bottom.
24 And Peach Bottom -- actually, it was a dual-unit trip,
25 and it was caused by a loss of multiple offsite power

1 lines, basically a lightning strike and momentary low
2 voltage on the other offsite power line.

3 This was a pretty complicated event with
4 -- Unit 3 had a -- the MSIVs went shut. The safety
5 relief valves had to open on Unit 3. The safety
6 relief valves, one of them stuck. Also, one of the
7 four diesel generators tripped. This was a pretty
8 complicated event for them. In this case, the risk
9 was in the E⁻³ to E⁻⁴ range.

10 And so at that level, we're at a higher
11 level of inspection team called the augmented
12 inspection team, and they were dispatched on 9/24 to
13 investigate, get a sequence of events, and try to
14 fully understand this event. They will -- they have
15 some preliminary findings, but the details haven't
16 really surfaced. Tomorrow they will be briefing the
17 utility on those findings.

18 I didn't conclude this, because the -- I
19 figure with the task force going on and hopefully they
20 can provide the right conclusion and recommendations
21 for this -- for these grid events.

22 MEMBER LEITCH: Okay. Thank you, Jerry.

23 Any questions for Jerry?

24 MEMBER SIEBER: Good presentation.

25 MEMBER LEITCH: Any concluding remarks?

NEAL R. GROSS

COURT REPORTERS AND TRANSCRIBERS
1323 RHODE ISLAND AVE., N.W.
WASHINGTON, D.C. 20005-3701

1 MR. FLACK: No, I think that pretty much
2 wraps it up. Bill's work -- well, again, as Bill
3 mentioned, will be out in NUREG form in November we're
4 shooting for with responses to comments that we've
5 received. So we'll be sending copies of those around.

6 MEMBER LEITCH: Okay. Does any of the
7 committee have anything else? Any concluding remarks?

8 MEMBER ROSEN: I presume we'll hear a lot
9 more about this.

10 MEMBER POWERS: Yes, I would expect so.

11 MEMBER LEITCH: We have put a little
12 picture on the back of the handout that I gave you, a
13 satellite picture of the northeast blackout. I just
14 thought it was an interesting picture.

15 Okay. Mr. Chairman, back to you.

16 CHAIRMAN BONACA: Okay. Thank you. That
17 was very informative, very well -- very good
18 presentation.

19 We are ahead of time. Let's take a break
20 now for 20 minutes, come back at 10 of 4:00, and then
21 we have -- Dr. Powers is going to tell us about the
22 research report.

23 (Whereupon, at 3:30 p.m., the proceedings
24 in the foregoing matter went off the
25 record.)

CERTIFICATE

This is to certify that the attached proceedings before the United States Nuclear Regulatory Commission in the matter of:

Name of Proceeding: Advisory Committee on
Reactor Safeguards
506th Meeting

Docket Number: n/a

Location: Rockville, MD

were held as herein appears, and that this is the original transcript thereof for the file of the United States Nuclear Regulatory Commission taken by me and, thereafter reduced to typewriting by me or under the direction of the court reporting company, and that the transcript is a true and accurate record of the foregoing proceedings.



Eric Hendrixson
Official Reporter
Neal R. Gross & Co., Inc.

A REVIEW OF THE PIRT PROCESS



Presented to:
Advisory Committee on Reactor Safeguards (ACRS)

Presented by:
Hossein P. Nourbakhsh
ACRS Senior Fellow

October 2, 2003

BACKGROUND

- The Phenomena Identification and Ranking Table (PIRT) process was originally formulated as a major step in CSAU evaluation methodology.
- The PIRT process, with some variations, has been used in much more applications that was originally envisioned.

BACKGROUND (Cont'd)

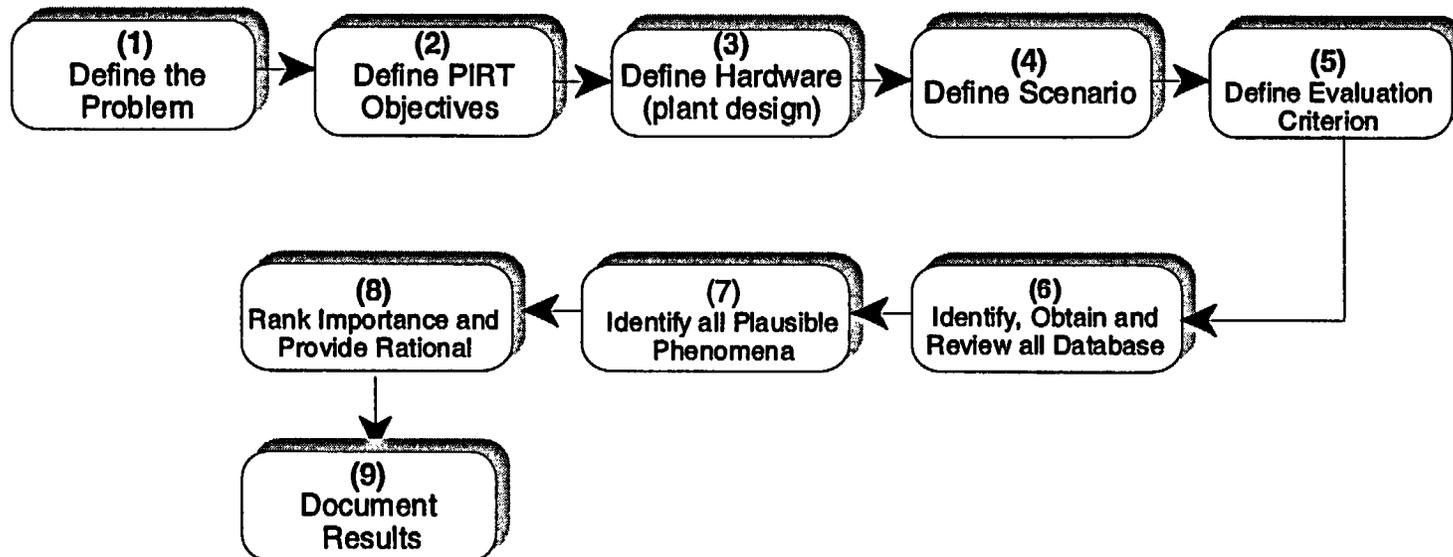
- In view of the wide spread use of PIRT process and its role in prioritization of research needs to address reactor safety technical issues, it is important to provide lessons learned from the past several years of experience with the PIRT process and to identify potential improvements for future PIRT development.

OBJECTIVE

- To review the PIRT process and its prior applications and to provide some suggestions for enhancement of the process

OVERVIEW OF THE PIRT PROCESS

Illustration of Typical Application of the PIRT Process



OBSERVATIONS

- Success in developing a useful PIRT is a strong function of the degree to which supplemental information are well documented. In most of the prior applications of PIRT process the technical basis and rational for importance ranking of many phenomena are not provided in sufficient depth that a reader can easily follow.
 - *This shortcoming is partly due to the lack of a systematic methodology that enables to capture all the implicit assumptions that an expert may make in arriving at an importance ranking for a plausible phenomenon*

OBSERVATIONS (Cont'd)

- It has been observed that individual panel members may be experts in some phenomena but be less familiar with others. To deal with this reality, panel members are informed that they need to vote only if they feel they have sufficient understanding of the importance of a phenomenon.

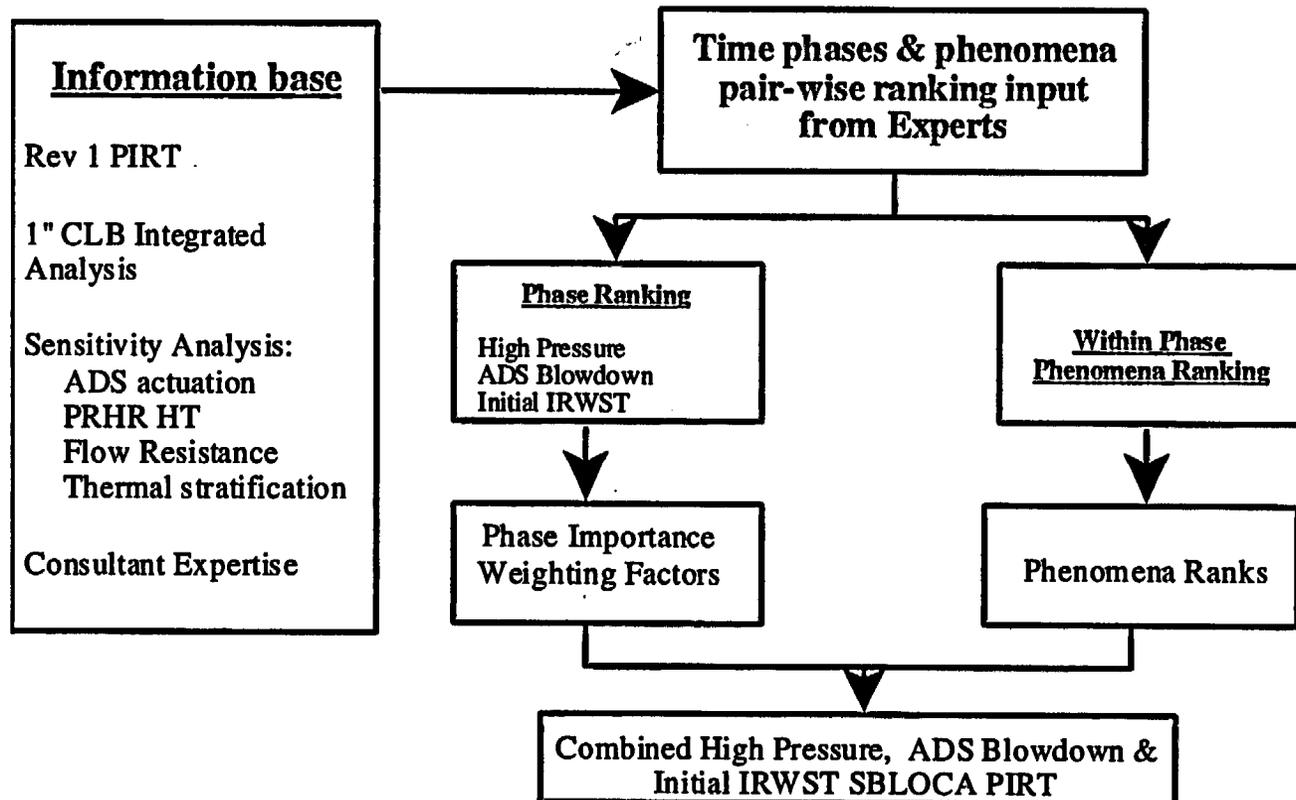
- *Since the panel members are asked to focus on importance of a phenomenon relative to the primary evaluation criterion, it is not clear whether this could always be done without making any implicit subjective judgment on importance of other phenomena that they may not be familiar with.*

OBSERVATIONS (Cont'd)

- In some prior PIRT efforts, pair-wise importance ranking of components and phenomena and the analytical hierarchy process (AHP) was utilized to determine the relative importance of phenomena and components.
 - *Many reactor safety technical issues involve interactions and feedback structure and do not have the linear top-to-bottom form of a hierarchy but look more like a network. Therefore, collapsing complexity into a simplistic hierarchic structure of few levels, and hoping to capture the effect of interactions implicitly in the form of highly condensed judgments is questionable*

OBSERVATIONS (Cont'd)

Conceptual application of AHP to AP600 SBLOCA short-term PIRT (NUREG/CR-6541)



OBSERVATIONS (Cont'd)

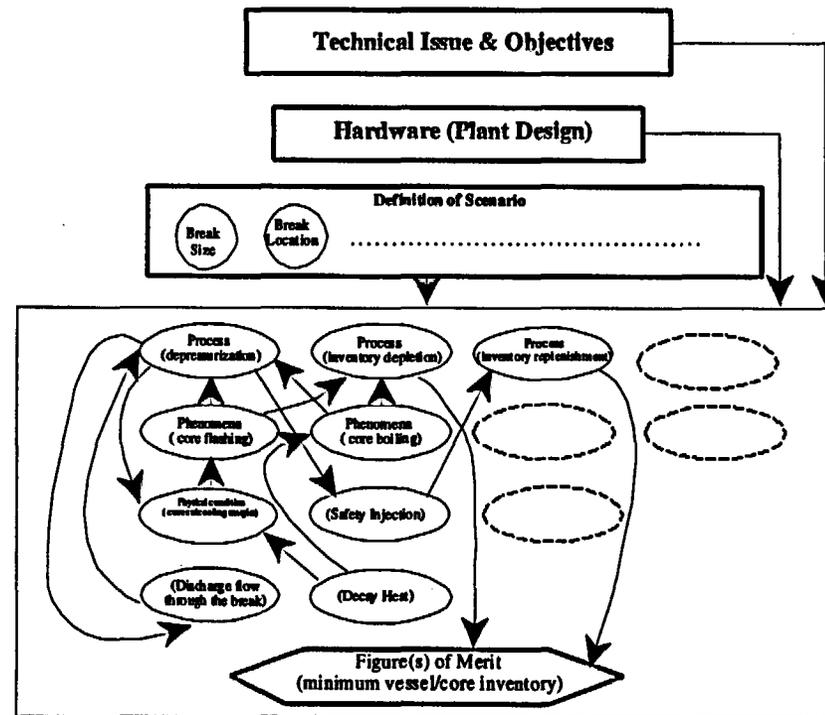
- Since the initial development of CSAU evaluation methodology and its associated PIRT process, procedures for expert elicitation, such as those documented in NUREG/CR-6372, "Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on Uncertainty and Use of Experts," have been developed. However, the evolving PIRT process does not seem to have benefited from such elicitation procedures.

RECOMMENDATIONS

- System dynamic techniques, such as influence diagrams (IDs), offer an attractive alternative framework to assess the importance of plausible phenomena for resolving a complex technical issue.
 - IDs indicate major factors in a system and what influence these have on each other.
 - Such diagrams provide an excellent tool for representing an expert's thought structures in the form of a network where nodes represent a factors and directed arcs joining nodes represent the relationship between them.

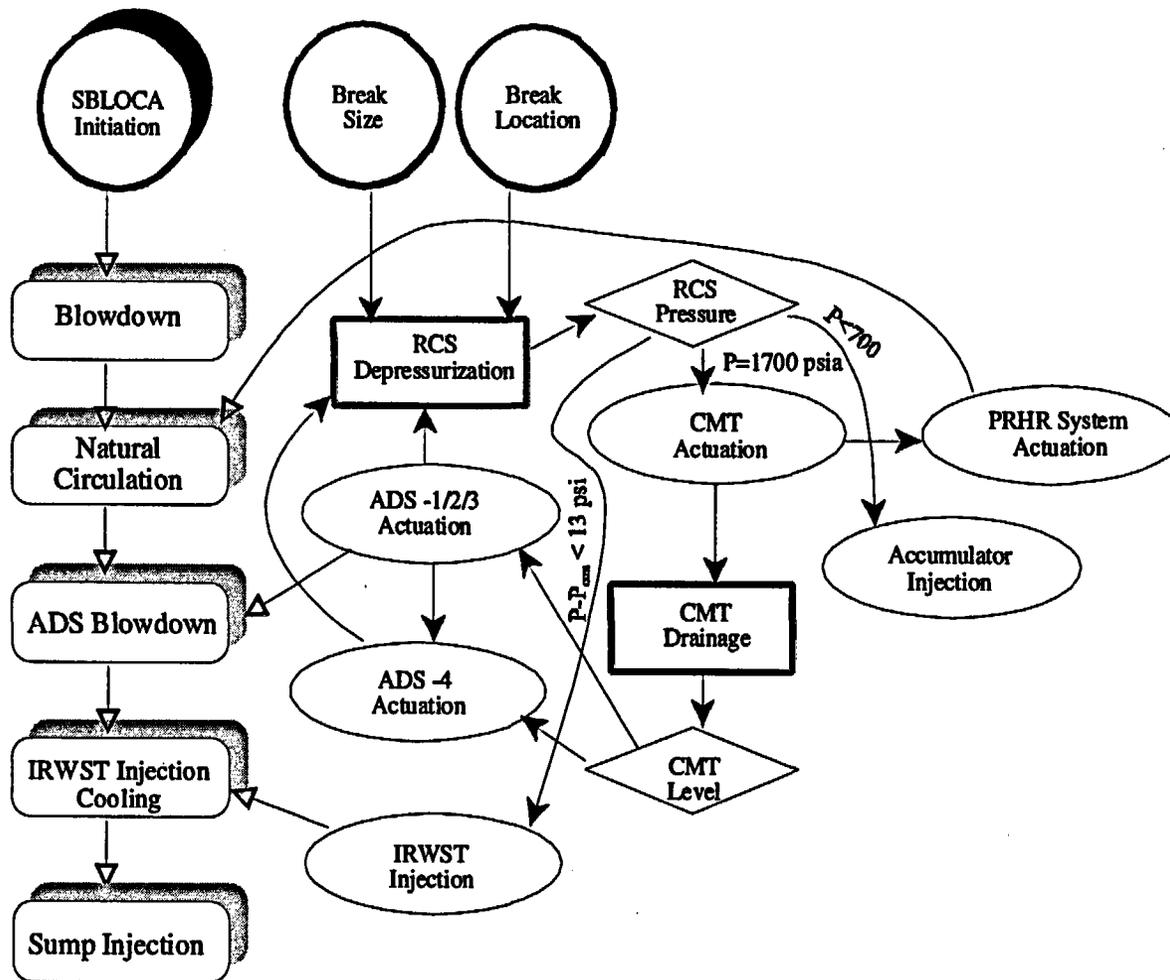
RECOMMENDATIONS (Cont'd)

Conceptual illustration of using influence diagrams to enhance the PIRT process



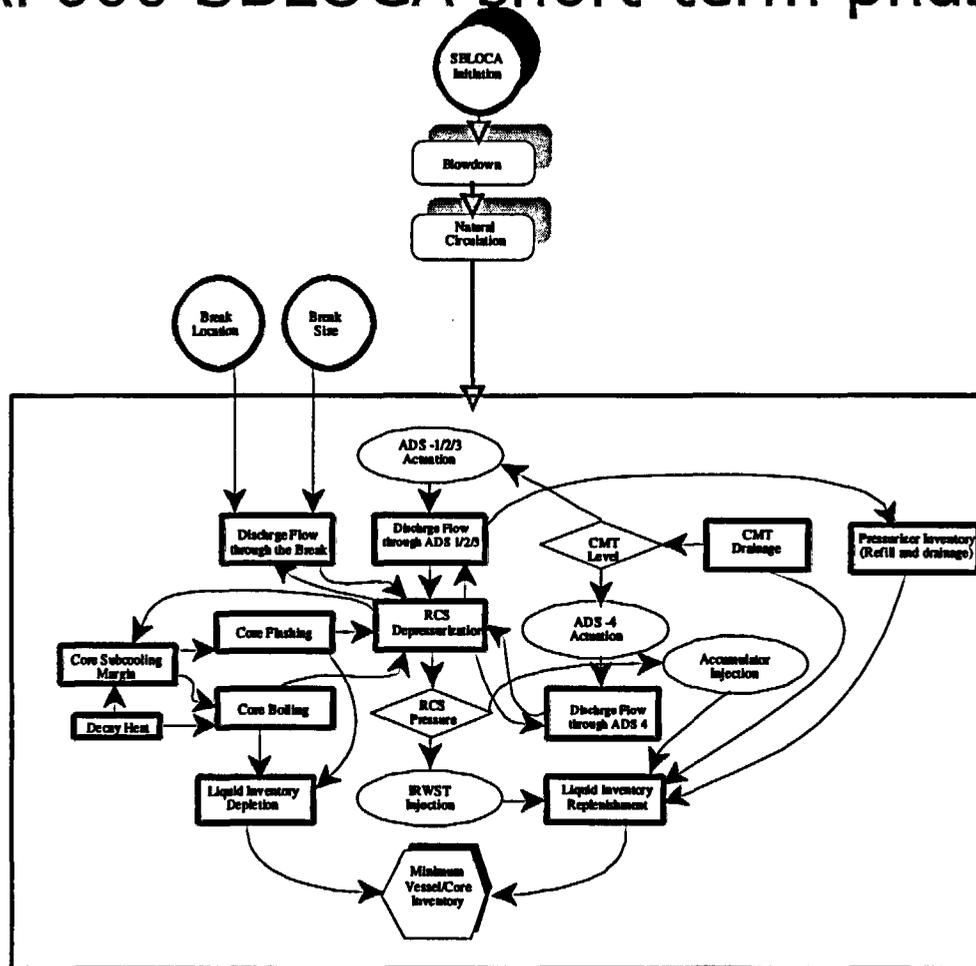
RECOMMENDATIONS (Cont'd)

Transient phases for AP600 SBLOCA PIRT



RECOMMENDATIONS (Cont'd)

Illustrative example of influence diagrams for AP600 SBLOCA short-term phase*



*Incomplete (for illustration only)

THE ADVANTAGES OF USING IDs

- IDs provide a more systematic context for capturing all the implicit assumptions that an expert may make in arriving at an importance ranking for a plausible phenomenon.
 - *Facilitate the development of adequate documentation that can later be utilized for an update or revision.*

THE ADVANTAGES OF USING IDs

(Cont'd)

- Elicited IDs provide a more transparent guidance for establishing the requirements in code development, assessment and improvement as well as for evaluation and specification for experimental programs.

THE ADVANTAGES OF USING IDs

(Cont'd)

- Using IDs for expert elicitation provides a framework that individual experts can make a judgment in their own areas of expertise without making any implicit subjective judgment on importance of other phenomena that they may not be familiar with.

RECOMMENDATIONS (Cont'd)

- Pair-wise importance ranking and the Analytical Network Process (ANP) may also be utilized, in conjunction with an influence diagram, to determine the relative importance of the processes, phenomena and components.

RECOMMENDATIONS (Cont'd)

- Potential use of the tools borrowed from the realm of qualitative reasoning and causal modeling, in conjunction with a qualitative influence diagram framework, should also be explored to further enhance the PIRT process.

SUMMARY

- A review of the PIRT process, noting its shortcomings, was provided.
- The use of influence diagrams as an alternative framework to identify and prioritize the physical processes which need to be addressed for resolution of a technical issue was also discussed.

Grid Reliability Issues

NRC Office of Nuclear
Regulatory Research

William S. Raughley,
Sr. Electrical Engineer



Agenda

- Background
- Changes on the Grid
- Impact on Nuclear Facilities
- Best Practices
- Conclusions

Background

- Long term review of operating experience
- SECY-99-129, "Effects of Electric Power Industry Deregulation on Electric Grid Reliability and Reactor Safety," May, 1999.
- Monitor and assess the grid
- "Operating Experience Assessment-Effects of Grid Events on Nuclear Power Plant Performance," April, 2003.
 - Initial draft for internal comment 11/02
 - Issued for stakeholder comment 5/03
 - NUREG scheduled 11/03

Background - Expectations

- 10 CFR 50 App. A
(GDC-17, Electric
Power Systems)
- Station Blackout Rule
(10 CFR 50.63)
- Maintenance Rule
(10 CFR 50.65)

Background

- In 1992, the National Energy Policy Act (NEPA) encouraged competition in the electric power industry, i.e., open generator access to transmission system and statutory reforms to promote wholesale generators.
- In 1996, FERC issued orders requiring open access to the electric power transmission system.
- Currently, 50% of states sell power in an open market, and have restructured to promote separate generating, and transmission and distribution companies.

What Has Changed on the Grid?

- Higher transmission system loading.
- Lower grid reactive capabilities.
 - PJM 1999 grid event
 - Reactor power uprates
- Changes in grid operating voltage limits and action levels.
- Increase in transmission line relief requests during summer.
- Increase in coordination times to recover from grid disturbance.

Challenging Safety Issues

- Most loss-of-offsite-power (LOOP) events occur during summer months.
- Increase likelihood of reactor induced LOOPs during summer.
- Longer time to recover from LOOP.
- Risk from
 - Low voltage condition
 - On-line EDG maintenance

Best Practices

- Consider the seasonal effects of grid performance on:
 - EDG maintenance and test practices
 - Switchyard maintenance practices
- Establish contractual arrangements between grid operators and NPPs to maintain secure electrical power.
- Use of real-time grid parameters when performing design basis electrical analysis.

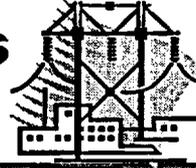
Stakeholder Comments

- Recognized the merit in periodically conducting grid assessments.
- NRC and industry should collaborate on an assessment of the relationship between deregulation, grid events, and NPP safety.
- Grid operators may not be fully aware of:
 - the more restrictive NPP bus voltage limits,
 - the grid condition during EDG maintenance,
 - pre-trip voltages necessary for safe shutdown.

Conclusions

- Changes in grid performance have occurred since operating in a deregulated environment.
- Grid performance can impact NPPs:
 - Response to accidents and transients
 - Blackout (coping) duration
 - Challenge safety equipment
- Need to seek a better understanding of grid performance.

Reactor Trip Events Caused by Grid



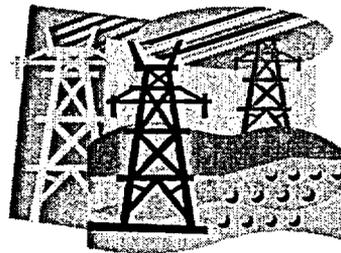
Jerry Dozier
Operating Experience
Section



1

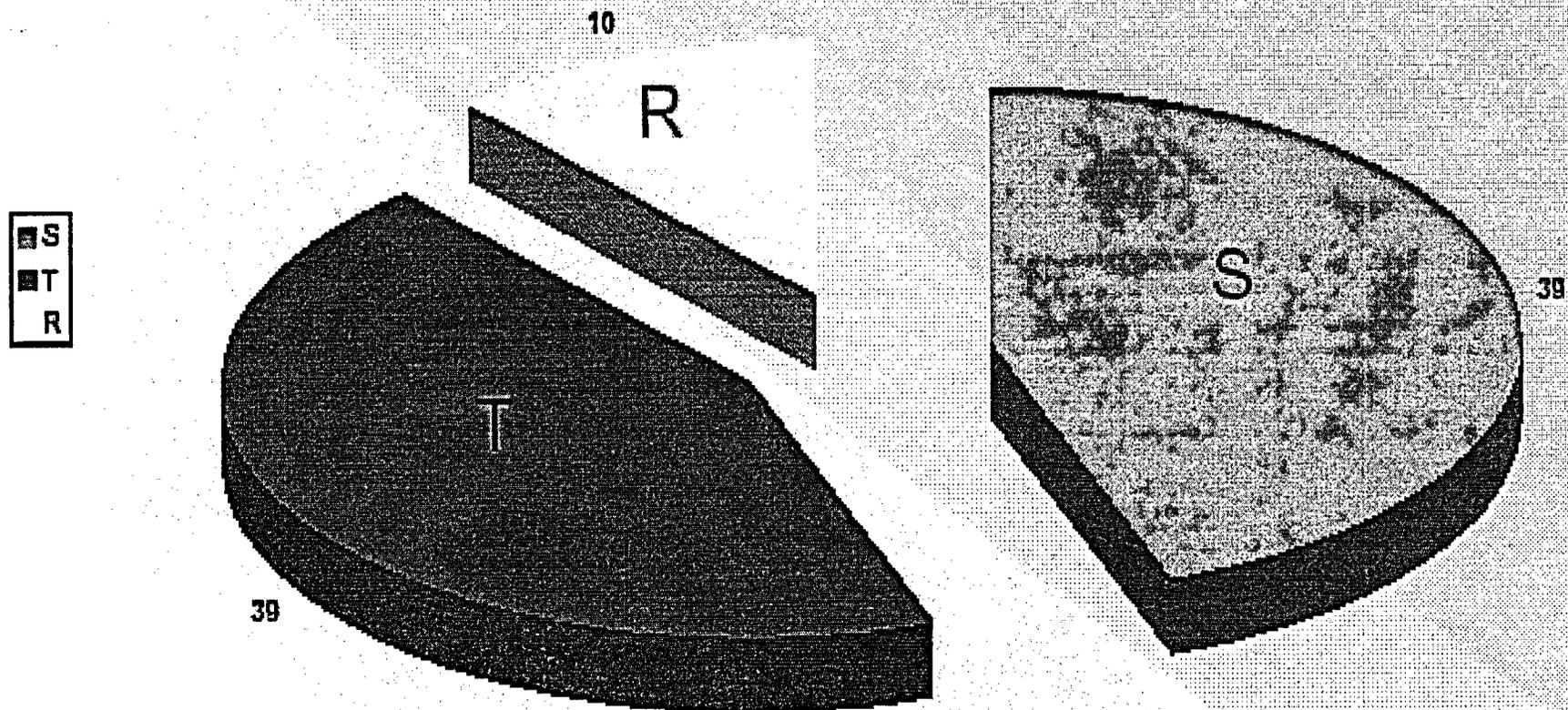
Objective

- **Graphically present recent grid event data**
- **Overview of 3 recent events and agency response**



2

Grid Events Resulting in Plant Shutdowns or Complicating Plant Shutdowns (1994-2003)

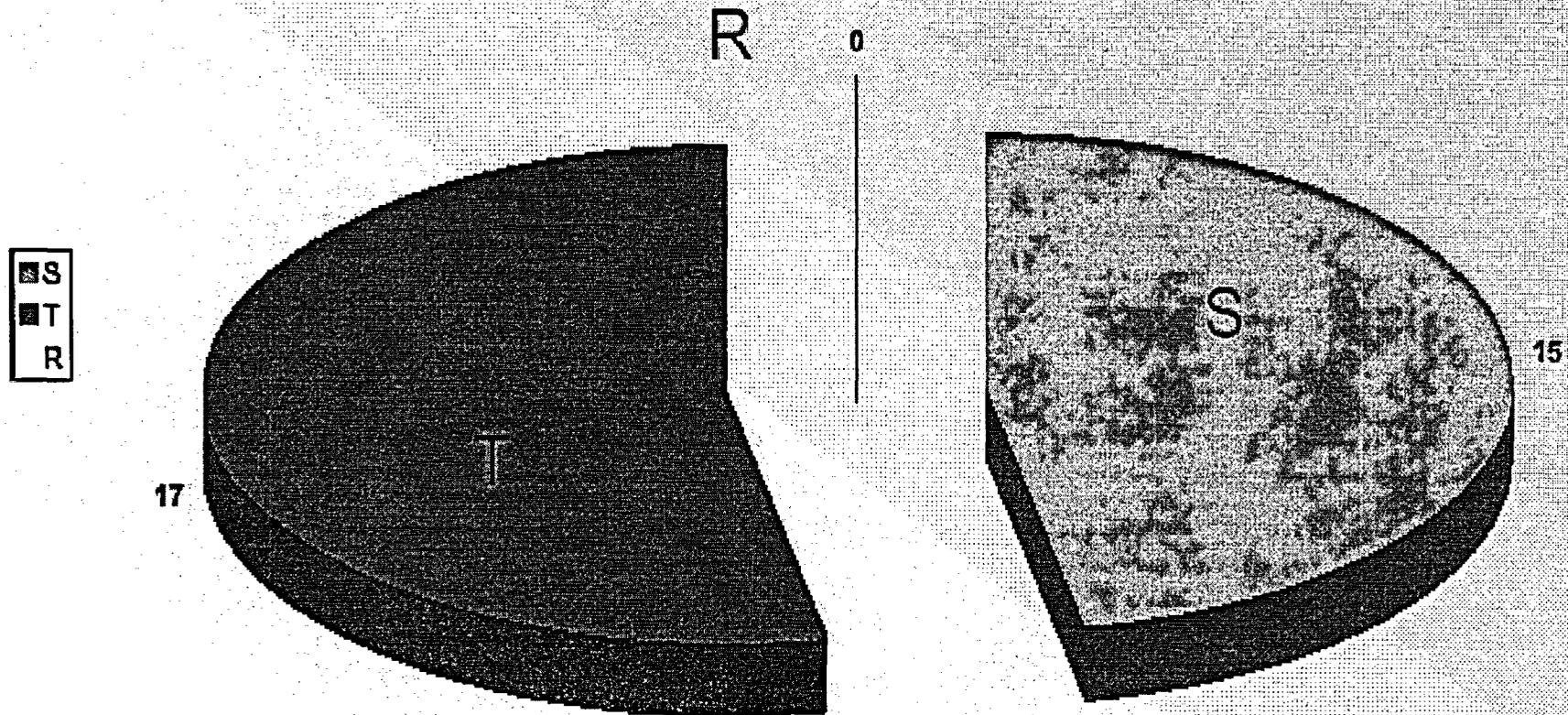


"S" events are reactor trips where the first event in the sequence of events leading to the reactor trip was in the switchyard or substation nearest the plant.

"T" events are reactor trips where the first event in the sequence of events leading to the reactor trip was in the transmission system beyond the switchyard or substation nearest the plant.

"R" events are losses of electric power from any remaining power supplies as a result of, or coincident with, a reactor trip at power.

Grid Events Resulting in Plant Shutdowns or Complicating Plant Shutdowns (2002- 2003)



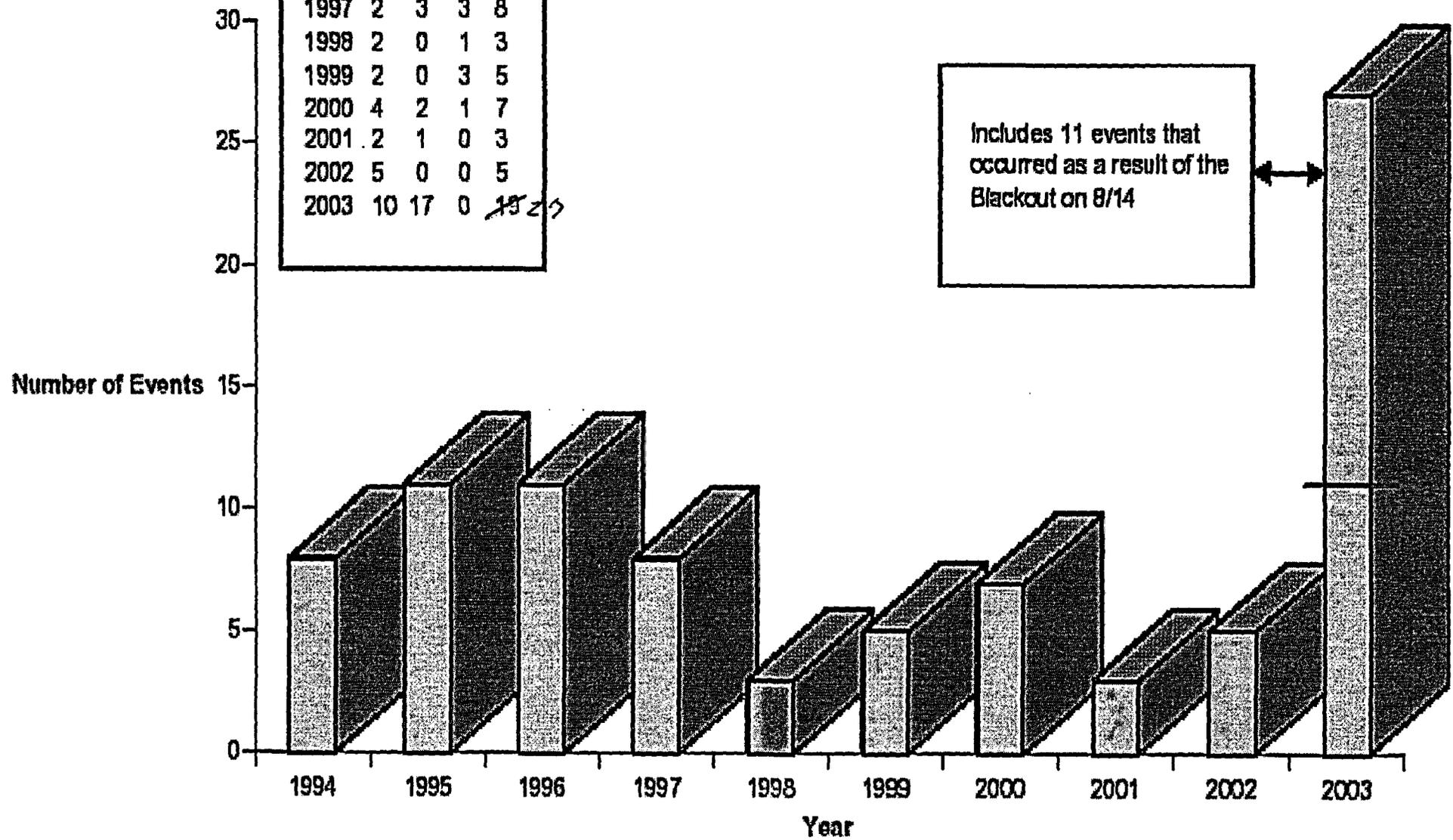
"S" events are reactor trips where the first event in the sequence of events leading to the reactor trip was in the switchyard or substation nearest the plant.

"T" events are reactor trips where the first event in the sequence of events leading to the reactor trip was in the transmission system beyond the switchyard or substation nearest the plant.

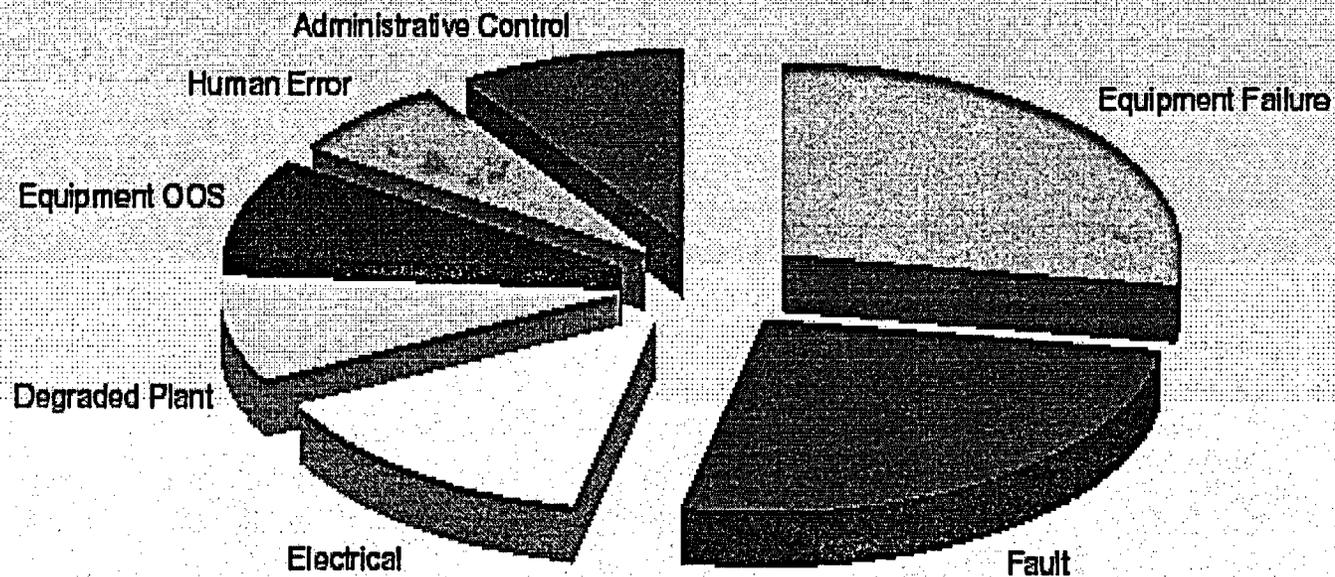
"R" events are losses of electric power from any remaining power supplies as a result of, or coincident with, a reactor trip at power.

Switchyard (S), and Transmission(T) Events Causing or Complicating (R) Plant Shutdowns from 1994 to Present

Date	S	T	R	RS&T
1994	4	4	0	8
1995	6	5	0	11
1996	2	7	2	11
1997	2	3	3	8
1998	2	0	1	3
1999	2	0	3	5
2000	4	2	1	7
2001	2	1	0	3
2002	5	0	0	5
2003	10	17	0	27

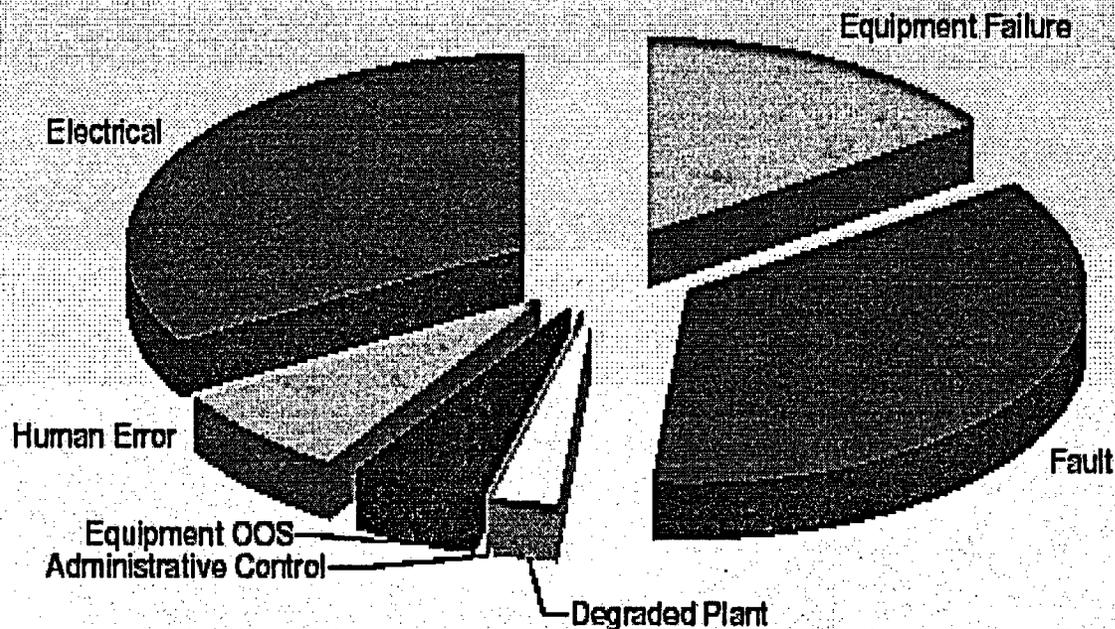


Causes for Grid Events 1994 - 2003

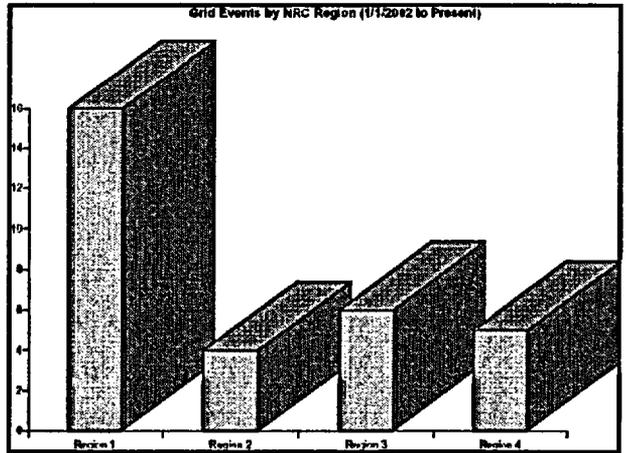
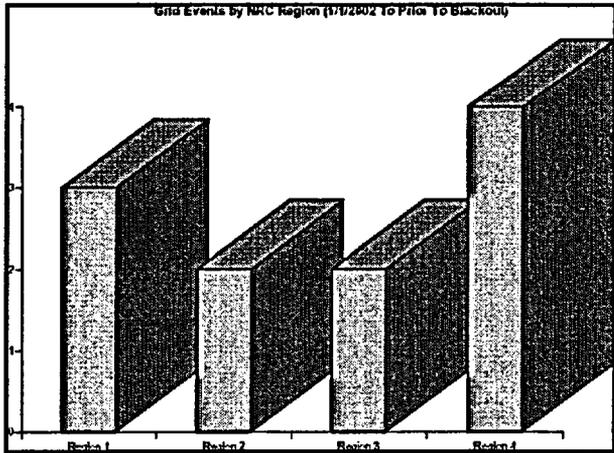
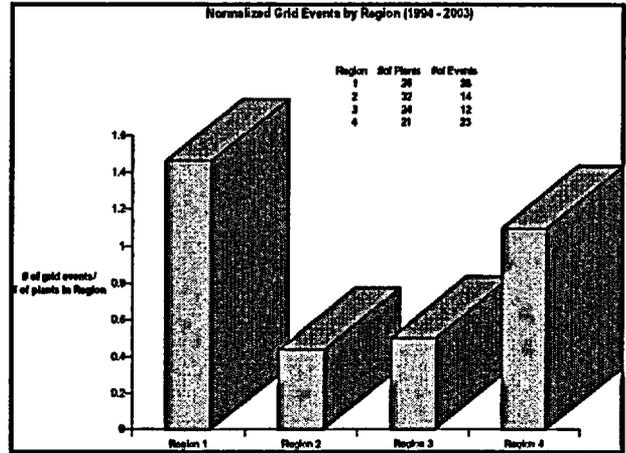
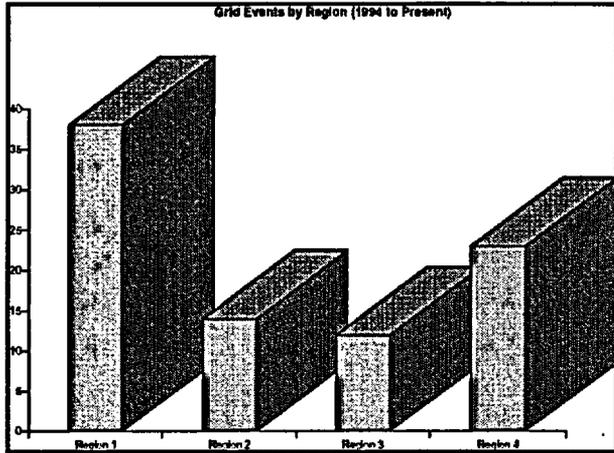


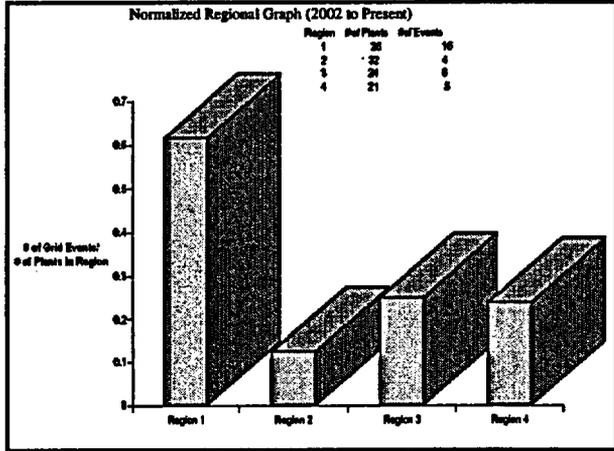
- Equipment Failure indicates switchyard or transmission equipment failed or mis-operated (mis-op).
- Fault indicates switchyard or transmission equipment faulted.
- Electrical indicates a weakness in the electrical capability of the grid (or grid and NPP combined) to support the NPP offsite voltage.
- Degraded Plant indicates degraded nuclear plant equipment contributed to the event.
- Human Error indicates human error by personnel that work for the transmission entity.
- Equipment OOS indicates that equipment under control of the transmission entity were out of service at the time of the event.
- Administrative Control indicates a lack of control of the transmission entity's activities

Causes for Grid Events 2002 - 2003



- Equipment Failure indicates switchyard or transmission equipment failed or mis-operated (mis-op).
- Fault indicates switchyard or transmission equipment faulted.
- Electrical indicates a weakness in the electrical capability of the grid (or grid and NPP combined) to support the NPP offsite voltage.
- Degraded Plant indicates degraded nuclear plant equipment contributed to the event.
- Human Error indicates human error by personnel that work for the transmission entity.
- Equipment OOS indicates that equipment under control of the transmission entity were out of service at the time of the event.
- Administrative Control indicates a lack of control of the transmission entity's activities

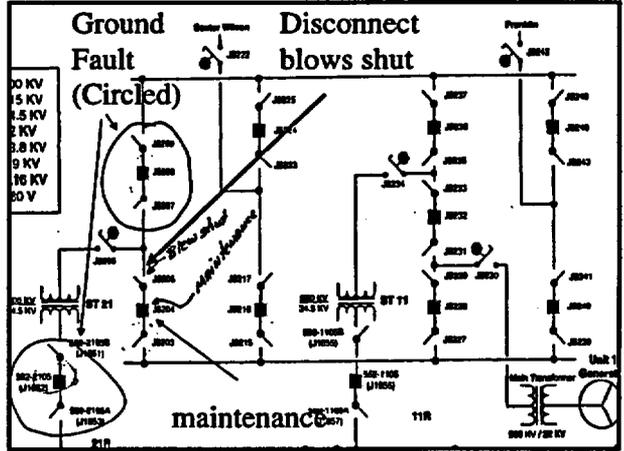
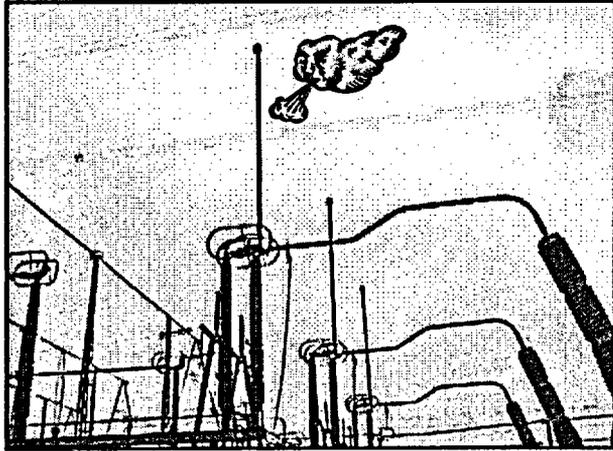


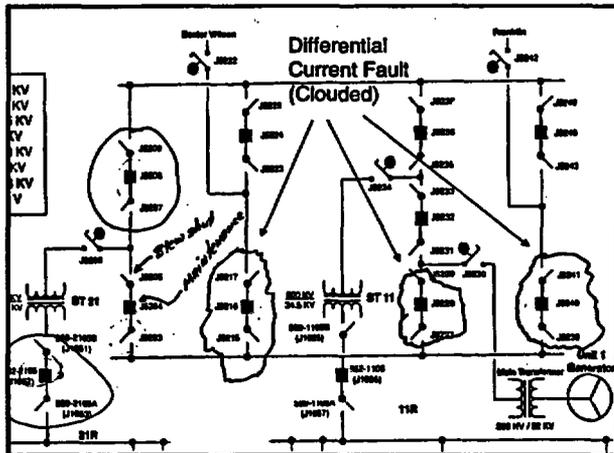


Grand Gulf

- High winds in the 500 kV switchyard blew a disconnect closed resulting in a partial LOOP (4/24/2003)
- Scram on load rejection
- Diesel generators energized safety busses
- Event is further complicated by the inability to promptly restore instrument air

13





Grand Gulf Agency Response

- **Risk: CCDP Range of 6.9E-6 to 3.3E-5**
- **Special Inspection and Regional Briefing by OES Performed**
- **SIT findings**
 - Failure of Grand Gulf Nuclear Station personnel to provide an adequate procedure for restoring the instrument air system following the loss of instrument air. (Green Finding)

17

Salem/Hope Creek

- **High winds and rough surf in the Delaware River during Hurricane Isabel (9/19/03) resulted in salt deposits in the 500kV switchyards at Salem and Hope Creek.**
- **These salt deposits caused electrical faults and arcing in both switchyards. Hope Creek scrambled and Salem manually shut down**

18

Hope Creek Agency Response

- **The licensee provided adequate justification for their actions and the plant response was well understood. Even though the event was in the lower range for special inspection, it is felt that a special inspection is not justified. However, an electrical regional inspector will followup as part of the routine baseline inspection.**

19

Peach Bottom 2 & 3

- Peach Bottom 2 & 3 - Dual unit trip (9/15/2003). The trip was caused by a loss of multiple offsite power lines (lightning strike) and momentary low voltage on the other offsite power line.



20

Peach Bottom Event Agency Response



- CCDP of E-3 for Unit 3 and E-4 for Unit 2.
- The difference between units is due to a stuck SRV on unit 3.
- Because of complications in mitigating this event, an Augmented Inspection Team was dispatched on 9/24 to investigate.

21