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ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

March 10, 2006

The contents of this transcript of the proceeding of the United States Nuclear Regulatory Commission Advisory Committee on Reactor Safeguards, taken on March 10, 2006, as reported herein, is a record of the discussions recorded at the meeting held on the above date.

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

1 UNITED STATES OF AMERICA
2 NUCLEAR REGULATORY COMMISSION

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4 ADVISORY COMMITTEE ON REACTOR SAFEGUARDS

5 530th MEETING

6 + + + + +

7 FRIDAY, MARCH 10, 2006

8 + + + + +

9 The meeting came to order at 8:30 in room T2B3
10 of 2 White Flint North, Rockville, MD, Graham Wallis,
11 Chairman, presiding.

12 PRESENT:

13 GRAHAM WALLIS	CHAIRMAN
14 GEORGE E. APOSTOLAKIS	MEMBER
15 J.SAM ARMIJO	MEMBER
16 MARIO V. BONACA	MEMBER
17 RICHARD DENNING	MEMBER
18 DANA A. POWERS	MEMBER
19 OTTTO C. MAYNARD	MEMBER
20 WILLIAM J. SHACK	MEMBER
21 JOHN D. SIEBER	MEMBER AT LARGE
22 THOMAS S. KRESS	MEMBER
23 JOHN LARKINS	DESIGNATED FEDERAL OFFICIAL
24 DAVID FISCHER	STAFF ENGINEER

25
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C O N T E N T S

Draft final revision for DG 1128 to	4
Regulatory Guide 1.97	
Criteria for accident monitoring	
instrumentation for nuclear power plants	
Evaluation of precursor data to identify	
significant operating events	39
Adjourn	

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

8:30 a.m.

CHAIRMAN WALLIS: The meeting will now come to order. This is the second day of the 530th meeting of the Advisory Committee on Reactor Safeguards.

During today's meeting the Committee will consider the following.

Draft final revision for DG 1128 to Regulatory Guide 1.97; criteria for accident monitoring instrumentation for nuclear power plants; evaluation of precursor data to identify significant operating events; future ACRS activities; report of the planning of procedures subcommittee; reconciliation of ACRS comments and recommendations; draft final ACRS report on the NRC Safety Research Program; and the preparation of ACRS reports.

This meeting is being conducted in accordance with the provisions of the Federal Advisory Committee Act. Mr. Sam Duraswellme is the designated federal official for the initial portion of the meeting.

We have received no written comments or requests for time to make oral statements from members of the public regarding today's sessions.

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

6 I now turn to my colleague, Jack Sieber,
7 to introduce us to the first item of the agenda.
8 Jack.

9 MEMBER SIEBER: Thank you, Mr. Chairman.
10 John Lamb prepared for each of you a binder which has
11 the pertinent documents for this morning's session.

12 Enclosed within it and key to that is IEEE
13 Standard 497-2002. And the Regulatory Guide 1.97
14 would endorse this particular IEEE standard with some
15 exceptions. And the staff will explain those
16 exceptions to us.

17 Now as a matter of background, this
18 standard, its predecessor standards, was - came in the
19 aftermath of TMI for accident monitoring
20 instrumentation. The first standard and its two
21 revisions were really proscriptive in nature in that
22 there were tables and lists of instruments that had to
23 exist in various types of plants and what their
24 qualifications should be.

25 This latest IEEE standard is far more

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1 flexible and more performance based. And instead of
2 the list of instruments, you now review the emergency
3 response guidelines. If, in Westinghouse plants
4 that's what they call them. And your emergency
5 operating procedures, abnormal operating procedures
6 and so forth.

7 And identify every place where an operator
8 does something based on an instrument that he reads.
9 And that becomes an instrument that is action and
10 monitoring instruments.

11 And because of that flexibility, there is
12 some care has to be taken and in the implementation of
13 the standard.

14 So without giving away the whole story
15 here, what I'd like to do is make a general comment
16 that I think the staff did a good job on, on this
17 particular one, and I'd like to introduce Bill Kemper,
18 who'll tell us what the staff intends to present.
19 Bill?

20 MR. KEMPER: Thank you, Jack.

21 Yes my name is Bill Kemper. I'm the
22 branch chief for the Instrumentation and Electrical
23 Engineering Branch in the Office of Research. As Jack
24 said, we are here today to present the final draft
25 version of Reg Guide 1.97 for the Committee's review

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1 and concurrence.

2 Some of the ACRS committees have seen the
3 majority of this information already during the June
4 14th, 2005 ACRS INC subcommittee meeting. However,
5 the document has been sent out for public comments,
6 review and comments, and we did receive a fair amount
7 of comments which we're going to cover those with you
8 today. And therefore the document has been revised.

9 So George Tartal, who's an INC engineer in
10 our branch is the author of this document, and he will
11 be providing the presentation today. Barry Markus is
12 up there with him, who is also an INC engineer in NRR.
13 And Barry is here primarily to provide information the
14 Committee may desire on this matter with regard to
15 regulatory issues or regulatory perspective, if you
16 will.

17 So Barry's also the technical lead with
18 NRR for the Reg Guide 1.97 program, and he's the
19 principal reviewer for all licensing applications
20 associated with that subject matter.

21 So unless there's any questions at this
22 time, we'll go ahead and get started with the
23 presentation. George?

24 MR. TARTAL: Good morning. My name is
25 George Tartal and I work in the Instrumentation

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1 Electrical Engineering Branch of the Office of Nuclear
2 Regulatory Research.

3 At the June 2005 ACRS digital INC
4 subcommittee meeting, I presented draft guide DG-1128.
5 DG-1128 was the draft version of Rev 4 of Reg Guide
6 1.97.

7 DG-1128 was released for public comment in
8 August of 2005. The staff has since received public
9 comments, provided responses to the comments, and made
10 the appropriate revisions to the Guide.

11 Today I present to the Committee the final
12 Rev 4 of Reg Guide 1.97, criteria for accident
13 monitoring instrumentation for nuclear power plants.

14 First I'll provide a brief background on
15 the history of accident monitoring, then I'll discuss
16 the current revision, Rev 3 of Reg Guide 1.97. Then
17 I'll provide a brief overview of the endorsed IEEE
18 Standard 497-2002, which is a revised standard for
19 accident monitoring criteria.

20 Then I'll describe the guide presented for
21 discussion today, Rev 4 of Reg Guide 1.97, focusing on
22 the regulatory positions contained within.

23 Next is a discussion of public comments
24 received and the associated staff responses, followed
25 by a conclusion.

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1 Instrumentation are required to monitor
2 variables and systems under accident conditions by 10
3 CFR, Part 50, Appendix A, Criteria 13, 19, and 64.

4 Rev 1 of Reg Guide 1.97 was issued as an
5 effective guide in August of 1977. Then the accident
6 TMI happened in 1979 and the lessons learned from TMI
7 and post-TMI action plan NUREG-0737 which was later
8 codified in 10 CFR 5034(F), resulted in Rev 2 to Reg
9 Guide 1.97 in December of 1980.

10 Rev 2 endorsed consensus standard ANSI/ANS
11 4.5-1980, and was to be implemented via NUREG 0737,
12 Supplement 1.

13 Rev 3, the current revision, was issued in
14 May of 1983. It continued to endorse ANSI/ANS 4.5-
15 1980, which has since been withdrawn and is now an
16 inactive standard.

17 In Rev 3, each -

18 MEMBER APOSTOLAKIS: So I'm sorry, what's
19 the difference between Rev 3 and Rev 2 then?

20 MR. TARTAL: Rev 2 provided a table of
21 design and qualification criteria - I'm sorry in Rev
22 3. Rev 2 had the design qualification criteria all
23 throughout the text of the document, so it was more of
24 an organization.

25 MEMBER APOSTOLAKIS: I see.

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1 MR. TARTAL: In Rev 3, each accident
2 monitoring variables assigned a variable type and a
3 category. The variable type is selected based on its
4 accident monitoring function, and the category is
5 selected based on the required quality level.

6 So let me briefly review for you the
7 variable types and categories used in Rev 3 since
8 we're going to talk about them later in this
9 presentation.

10 The proscriptive tables of accident
11 monitoring variables are organized by variable type.
12 Type A are for planned manual actions with no
13 automatic control.

14 Type B are for assessing plant-critical
15 safety functions.

16 Type C are for indicating a potential or
17 actual breach of fission product barriers.

18 Type D are for indicating safety system
19 performance and status.

20 And Type E are for monitoring radiation
21 levels, releases, and environs.

22 So these are the five types of variables
23 that are defined in Rev 3.

24 The design and qualification criteria
25 applicable to each variable are determined by one of

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1 three assigned categories.

2 Category 1 is for indicating the
3 accomplishment of a safety function, and analogous to
4 safety-related instruments.

5 Category 2 is for indicating safety system
6 status, and analogous to augmented quality-related
7 instruments.

8 Category 3 is for backup and diagnostic
9 variables, and analogous to non safety-related
10 instruments.

11 So let me give you a few examples.
12 Primary containment pressure is required for
13 monitoring containment integrity. And that's a Type
14 B, Category 1 variable.

15 Containment atmosphere temperature is
16 required for monitoring containment cooling system
17 status. That's a Type D, Category 2.

18 Everybody with me? Good.

19 IEEE Standard 497-2002 was created to
20 consolidate the criteria from inactive standards
21 ANSI/ANS 4.5-1980 and IEEE Standard 497-1981, as well
22 as from Reg Guide 1.97, Rev 3.

23 It provides a technology-neutral approach
24 intended for advanced design plants. It takes a
25 performance based and non-proscriptive approach to the

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1 selection of accident monitoring variables.

2 The proscriptive tables of BWR and PWR
3 variables from Rev 3 have been replaced by variable
4 selection criteria based on the design basis accident
5 mitigation functions. This is the most significant
6 change from Rev 3.

7 Another significant change from Rev 3 is
8 that the selected variable type determines which
9 performance design qualification, display and quality
10 assurance criteria are applicable as categories are no
11 longer used.

12 MEMBER SIEBER: I'd like to point out that
13 when you talk about this being applicable to the
14 advanced design plants, I think that there are some
15 plants where this would not be particularly suitable.

16 Some concepts, for example gas reactors,
17 molten salt, and that kind. I see this as totally
18 applicable, however, to evolutionary plants, which
19 will probably be the next generation that comes along.

20 But this, this will be revised again if we
21 get into more exotic reactor types, I'm sure.

22 MR. TARTAL: Thank you.

23 So this slide gives a brief overview of
24 the criteria and the standard. The definitions for
25 variable types A, B, C, D and E are similar to the

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1 definitions that were in Rev 3. Some typical source
2 documents are referenced for each variable type, like
3 EOPs, EPGs, and AOPs.

4 The performance criteria include range,
5 accuracy, response time, duration, and reliability.
6 Design criteria include single and common cause
7 failure, independence, separation, isolation, power
8 supply, calibration, and portable instruments.

9 Qualification criteria include
10 environmental and seismic qualification. Display
11 criteria include display characteristics,
12 identification, display types, and recording. And
13 finally, quality assurance criteria are given.

14 So that brings us to the final guide as it
15 exists today. Rev 4 of Reg Guide 1.97 was prepared as
16 a response to a user need request from NRR. It
17 endorses IEEE Standard 497-2002, with exceptions and
18 clarifications.

19 It's intended for new nuclear power
20 plants, while conversion to the new criteria by
21 current operating plants is recommended on a
22 comprehensive and strictly voluntary basis. And we'll
23 talk more about that in a moment.

24 It was issued for public comment as draft
25 guide DG-1128 in August of 2005. The staff has since

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1 resolved the public comments and produced the final
2 guide.

3 The final guide takes eight regulatory
4 positions against the IEEE Standard.

5 The first regulatory position addresses
6 the question, how might current operating plants using
7 Rev 2 or 3 of Reg Guide 1.97 convert to the criteria
8 in IEEE 497?

9 The standard states it's intended for new
10 plants, but "the guidance provided in this standard
11 may prove useful for operating nuclear power stations
12 desiring to perform design modifications or design
13 basis modifications."

14 Now the staff has been contacted by the
15 industry concerning Rev 4 and informed that there is
16 interest in applying it to current plants. The
17 problem is that the standard doesn't tell you how
18 current plants should apply it.

19 So what if current plants want to use all
20 the guides and convert to the new method? Now by the
21 term convert, we mean revising all of their accident
22 monitoring licensing commitments to Rev 4.

23 Now the standard, since it's intended for
24 new plants, does not provide any guidance in
25 translating from specifying variable types and

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1 categories to only specifying variable types.

2 Categories do not directly correlate to
3 variable types. Although generally, Types A, B, and
4 C correlate to Category 1, Type D correlates to
5 Category 2, and Type E correlates to Category 3, with
6 some exceptions.

7 The individual criteria for a particular
8 variable type may be more or less stringent than what
9 is currently met. And the converted variable should
10 meet all of the new criteria for that variable type.

11 Although Rev 4 is intended for licensees
12 of new nuclear power plants, current operating plants
13 may convert to the new criteria on a voluntary basis.

14 Partial conversions by variable or system
15 or other grouping could result in an incomplete
16 analysis where there is the potential for some, some
17 variable or system interactions to be left unanalyzed
18 and unmonitored.

19 The staff does not endorse partial
20 conversion.

21 MEMBER KRESS: Could you expand on that a
22 little bit? I'm not really sure what you mean by an
23 incomplete analysis.

24 MR. TARTAL: By incomplete analysis, what
25 we're talking about here is if, if a plant wanted to

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1 do a partial conversion, in other words on say one
2 variable or one system, there may be some other
3 interactions with that system or with that variable
4 that could be left unmonitored as a result of only
5 converting this one variable.

6 We don't want them to say, take a tunnel
7 vision approach to this.

8 MEMBER APOSTOLAKIS: So it's all or
9 nothing?

10 MR. TARTAL: That's what we're
11 recommending. All or nothing. This is our guidance

12 MEMBER APOSTOLAKIS: Isn't that the same
13 as the requirement for fires and FBA 805 you either
14 convert to it or you don't?

15 MEMBER KRESS: Yes.

16 MEMBER APOSTOLAKIS: You can't just pick
17 and choose.

18 MEMBER SIEBER: I think one of the
19 difficulties is that Type A instruments in the new
20 standard, to me at least, seems to encompass more
21 instruments than in the old standard because you're
22 talking about contingency actions.

23 MR. TARTAL: Yes.

24 MEMBER SIEBER: Which is the subject of
25 your regulatory position four. And so the numbers of

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1 instruments that are in Type A will be greater under
2 the new standard, and because Type A is the most
3 stringent qualification requirement, you may have to
4 backfit the plant to establish the appropriate
5 qualification under the new standard.

6 In other words, do a physical change to
7 the plant if you're required to implement the entire
8 standard for every accident monitoring variable.

9 On the other hand, if I look at the
10 standard, there's some things in the new standard that
11 aren't in the old standard. For example, discussion
12 of digital instrumentation and defense and death and
13 diversity and how these things should be incorporated
14 into your system. I think these concepts are pretty
15 important, and I agree with the standard writers that
16 they did a pretty good job in doing that.

17 And I would hate to forego the opportunity
18 to apply these very good concepts that are in the
19 standard to an instrument system that I'm going to
20 modify and so I ignore or forget about this standard,
21 this latest standard, because I don't want to have to
22 go through the plant and requalify a bunch of other
23 instruments that aren't related to it.

24 MEMBER APOSTOLAKIS: But, Jack, when you
25 say an instrument system, what do you mean? A set of

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1 -

2 MEMBER SIEBER: A set, a train, for
3 example, to me is an instrument system that goes from
4 the primary sensing element all the way to some kind
5 of display. That would be the smallest thing.

6 MEMBER APOSTOLAKIS: If you have -

7 MEMBER SIEBER: Okay and instruments - go
8 ahead.

9 MEMBER APOSTOLAKIS: If you have a safety
10 function, okay, and you're monitoring parameters using
11 a number of systems, then you're saying that I should
12 be able to modify one of them using these new ideas
13 and leave the others with the old standard?

14 MEMBER SIEBER: Yes. Well that would be,
15 to me that would be, that's what the staff calls
16 picking and choosing. And they don't like that
17 concept.

18 To me I think that if you do the right
19 analysis to make sure that you continue to cover all
20 the variables, that's what I think about when I think
21 in terms of analysis that needs to be done.

22 I don't think I would want to be in a
23 position of them backfitting the plant.

24 MEMBER KRESS: It seems to me like, if I
25 were going to convert wholly over, I would go through

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1 the analysis and find out which instruments go in
2 which category that I have. I don't know how, how to
3 have them all categorized and limited, but now I'm
4 going to start changing whatever it is you have to
5 change in order to make them into the new thing.

6 I see no reason why they all ought to be
7 changed at one time. Because I've already got the
8 analysis made, and there's not an incomplete analysis
9 there, so I may want to change half of them one
10 shutdown and half of them another.

11 So the question I have is what, what is
12 meant by complete changeover? I mean, does that have
13 to be done all at one time, or can I do it in
14 increments?

15 MR. TARTAL: The intention is all at one
16 time.

17 MEMBER MAYNARD: I guess I'm not convinced
18 that they're all or none. I do agree with just
19 picking. I don't think you want to allow hey this
20 instrument and over here and do that, but if a plant
21 is modifying a system, putting in a new design, later
22 technology, I don't believe it would be that difficult
23 to envelope that new system to be able to define that
24 without losing the rest of it there.

25 And I think you might be discouraging

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1 some, well, incentive to go to some of the newer
2 technology, and also it may make it more difficult to
3 have the staff to have criteria to review.

4 I'm not sure you want to take away the
5 option to do it, but again I also I don't believe that
6 plant should be able to come in and just, I want to
7 change this instrument to this new standard and just
8 kind of a hodgepodge of it.

9 But if you're putting in a new design, if
10 you're modifying a system, I think you need to be
11 taking a look at what is the best standard to address
12 that new design system. And I think you should be
13 able to encompass that.

14 MEMBER KRESS: I think they ought to allow
15 incremental changes.

16 MEMBER APOSTOLAKIS: No, but, would it be
17 more acceptable to convert to the new system if you're
18 dealing with a safety function rather than a
19 particular system?

20 Would that be more acceptable?

21 MEMBER SIEBER: Well, that might not be
22 accident monitoring if it actually performs an action.
23 These are things that - accident monitoring isn't Type
24 A. Or operator manual actions that the operator takes
25 by reading his procedure and seeing some indication on

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1 some instrument as opposed to having it on automatic
2 trip or something like that.

3 I think the perfect example, at least in
4 Westinghouse plants, is the old analog were out of
5 position in the cable system. Which was known to be
6 inaccurate and subject to changes in reactor outlook
7 temperature because of changes in the reluctance of
8 the control rod guide tubes. And a lot of, not a lot
9 but some, licensees converted to a digital-type system
10 which is designed to overcome some of these physical
11 difficulties that the system had.

12 You could apply this new standard very
13 easily to a new digital rod position indicating
14 system, but you would probably not do it if you had to
15 convert everything in the plant to the new standard
16 because it would now bring into the fold as Type A
17 variables, a lot of variables that you formerly didn't
18 consider Type A variables.

19 It may change your qualification
20 requirements on some instruments. You might have to
21 redo the seismic analysis or the EQ envelope or
22 something like that. Or separation criteria.

23 And so there's some difficulties in
24 regulatory position one.

25 MEMBER BONACA: I wonder if they have an

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1 example that substantiates your concern. I mean - do
2 you have an example?

3 MR. KEMPER: Yes. This is Bill Kemper.
4 If I could just try. Let's say for example at a BWR,
5 Reg Guide 1.97 would require that they have position
6 monitoring available for their code safeties on a
7 primary system.

8 The intent is to monitor primary system
9 leakage, right, a leakage path. Another way of doing
10 that could be using the AOPs, just look at reactor
11 coolant system pressure. Look at reactor building
12 sump level. Look at quench tank pressure. There's
13 many different ways in monitoring a reactor coolant
14 system leakage.

15 So a licensee could come in and make an
16 argument to say that we don't need these position
17 indicators, which are probably problematic to maintain
18 on the code safeties because we have other alternative
19 means to monitor that.

20 But some of those alternative indications
21 may or may not be in Reg Guide 1.97. So they would
22 effectively - our concern is they could effectively
23 gerrymander or just cherry pick, if you will, to
24 eliminate this one problematic indicator without
25 including the other balance of indications that

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1 they're going to take credit for and that they would
2 use pursuant to their EOPs.

3 That's one concern. The second concern is
4 that from an inspection standpoint, it will be very
5 difficult, I think, for the resident and the regional
6 inspectors to come in and inspect a licensee for
7 compliance of Reg Guide 1.97 if he has a potpourri of
8 commitments, if you will, you know between Rev 2, Rev
9 3 and Rev 4.

10 So that's the other part of it. We were
11 concerned that it may be very difficult, if manageable
12 at all, by the resident inspectors and regional
13 inspectors to inspect for compliance of this
14 particular document.

15 MR. TARTAL: Or the licensees for that
16 matter.

17 MEMBER SIEBER: But the licensee is
18 required to maintain his current licensing basis which
19 to me means there ought to be documents that show
20 which instruments belong to which version of the
21 standard.

22 MEMBER SIEBER: I think I agree that one
23 of the problems here is the fact that a licensee could
24 do just exactly what you said and decide all I have to
25 do is change my EOPs and eliminate reference to this

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1 instrument and figure out another way to do it, and
2 then since it isn't in the EOPs anymore, it's not
3 subject to the standard anymore so I can take it out,
4 or retire it in place or do whatever I want.

5 I think that we have to guard against
6 that. On the other hand, there is a price to pay for
7 such a guarded approach.

8 MEMBER MAYNARD: Well, I think you bring
9 up some valid concerns. I'm still not sure that you
10 want to just totally close the door on it. I think
11 NRR, NRC still has control over whether you authorize
12 a change to a licensing, just somebody comes in. And
13 I think it would put the burden on the utility to
14 demonstrate that it doesn't lose some of the things or
15 create a problem.

16 They would have to show, I think, how is
17 it clear to the inspector what to be inspected to, and
18 how are they going to maintain it. I think the NRC
19 still has control of whether or not they approve that.
20 I'm just not sure you want to close the door in a hard
21 and fast rule and say no.

22 MEMBER SIEBER: I think though that the -
23 you know it almost sets the staff out like they're
24 potentates some place. They actually have to follow
25 the rules, too. And so their hands are somewhat tied

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1 to whatever they approve at this time as far as the
2 standard's concerned. They can't make the licensee do
3 something that isn't in the rules.

4 MEMBER APOSTOLAKIS: Yes, but I thought,
5 coming to your argument, or Bill's argument is that
6 the staff will have difficulty evaluating such
7 situations. They would probably need further guidance
8 of some sort.

9 MEMBER BONACA: And so the licensee would-

10 MEMBER APOSTOLAKIS: The NRC does have
11 control, but can they actually do something
12 meaningful? I think that's the argument from the
13 staff.

14 MEMBER SIEBER: I think you can make the
15 same argument in the fire protection area. For
16 example, there are so many different ways depending on
17 how old your plant is and how it was licensed and NFP
18 805 introduces just another one of these variations.

19 Where a licensee, you know, has to keep
20 track via some kind of a documented road map is just
21 where they are in licensing space and what their
22 design basis really is.

23 And if you can do it in fire protection,
24 I would think that you could do it in instrumentation.
25 I give the staff and its inspectors credit for being

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1 able to wander through applications of more than one
2 standard.

3 MR. TARTAL: Again, we're not putting
4 forth a requirement here. This is only our
5 recommendation.

6 MEMBER SIEBER: Right.

7 MR. TARTAL: Hence it being a Reg Guide.

8 MEMBER APOSTOLAKIS: What does that mean?

9 MEMBER SIEBER: Yes, which means a
10 licensee could go and get an exemption should the
11 staff see fit to approve it.

12 MR. TARTAL: That would be a deviation in
13 this case, but yes.

14 MEMBER SHACK: You didn't have to ask for
15 an exemption here.

16 MEMBER POWERS: No.

17 MEMBER SHACK: Meaning just come in and
18 say I did it differently, please approve it.

19 MR. TARTAL: Exemptions are for rules.

20 MEMBER POWERS: I will comment, Jack, that
21 with respect to your fire versus instrumentation
22 analogy, that you drew there. Recall that when we
23 were going through the triennial fire inspections, we
24 found most licensees had not done a good job of
25 preserving the licensing basis for fire protection.

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1 MEMBER SIEBER: I know that. I had
2 listened to various staff people complain about that.
3 Okay, why don't we continue on.

4 MR. TARTAL: Very good.

5 The second regulatory position addresses
6 calibration during an accident. The standard requires
7 maintaining instrument calibration by means of
8 recalibration, proper calibration interval
9 specification, selecting equipment that does not
10 require calibration, or by cross-calibration with
11 other channels having no relationship to that
12 variable.

13 Recalibration is the only one of these
14 means, though, that can satisfy the requirement to
15 maintain calibration. The staff position is that
16 validating instrument calibration is more appropriate
17 than maintaining instrument calibration during an
18 accident.

19 The third regulatory position addresses
20 severe accidents. The IEEE standard does not directly
21 address severe accident monitoring, although it is
22 mentioned as future work for the standard.

23 The standard does, however, include the
24 requirement for Type C variables to have extended
25 ranges, which was a post-TMI action item now

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1 incorporated in 10 CFR 5034(F).

2 This regulatory position incorporates the
3 language from NUREG-660, the post-TMI action plan,
4 into the criteria to clarify the need for extended
5 ranges for Type C variables. Again this is not a new
6 requirement, but only a clarification.

7 MEMBER SIEBER: On the other hand, you
8 when you're doing your classification, your analysis,
9 you can screen out instruments that would be used
10 beyond the design basis of a plant, right?

11 MR. TARTAL: Yes, and you'll see that a
12 little later in the presentation, yes.

13 The fourth regulatory position addresses
14 contingency actions. Contingency actions are defined
15 by the IEEE Standard as alternative actions taken to
16 address unexpected responses of the plant or
17 conditions beyond its licensing basis.

18 The standard excludes all contingency
19 actions from the scope of potential Type A variables.
20 The term contingency action is applied as if they are
21 to mitigate accident conditions that are beyond
22 licensing basis of the plant.

23 However, the definition of the term
24 provided by IEEE may not exclude some licensing basis
25 conditions related to unexpected responses of the

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1 plant.

2 Therefore, the staff position is that this
3 restriction toward contingency actions should not be
4 endorsed. Instead, the licensee should consider all
5 operator actions within the licensing basis during the
6 variable selection process.

7 MEMBER SIEBER: I guess when I read this
8 one and thought about this combined with the first
9 regulatory position, that was, to me, the killer.
10 Because this is where the extra work comes from is the
11 contingency action.

12 Had you not had this then it would be
13 neater to accept a wholesale conversion to the new
14 standard when you decide to make the change to the
15 plant.

16 But this combination to me makes it more
17 difficult.

18 MR. TARTAL: Again, the consideration of
19 contingency actions does not necessarily increase the
20 number of Type A variables that will be monitored.

21 It's up to the licensee to evaluate their
22 contingency actions and how they use them and
23 determine whether it really is a Type A variable or
24 not.

25 MEMBER SIEBER: Yes, but to actually have

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1 to do the work in order to find out whether you're
2 right or not.

3 MR. TARTAL: That's correct.

4 MEMBER SIEBER: And I don't think you have
5 - or I know I haven't.

6 MR. TARTAL: The fifth regulatory position
7 addresses the number of points of measurement for a
8 variable. It's not addressed in the IEEE Standard,
9 but was addressed as a regulatory position in Rev 3.

10 The regulatory position recommends the
11 number of points of measurement for each variable
12 should be sufficient to adequately indicate the
13 variable value.

14 The sixth regulatory position addresses
15 the codes and standards referenced within the IEEE
16 Standard. This is a boilerplate regulatory position
17 for Reg Guides that endorse industry standards.

18 It provides guidance on how a licensee
19 should use those reference codes and standards
20 depending on whether they're codified in regulations,
21 endorsed in Reg Guides, or neither codified nor
22 endorsed.

23 The seventh regulatory position addresses
24 Type C variable operating time. The standard requires
25 at least 100 days of operating time for Type C

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1 variables.

2 The staff position is that licensees may
3 optionally use an operating time that is specified in
4 their licensing basis documentation, which is
5 consistent with the criteria for the other four types
6 of variables.

7 The eighth regulatory position replaces
8 the term "post event operating time" with "operating
9 time" in the IEEE Standard. This language is
10 consistent with the title change of the standard from
11 "post accident monitoring" to "accident monitoring".
12 The staff position is that the operating time should
13 encompass the full accident duration.

14 Now to discuss the public comments
15 received on the draft guide and the related staff
16 responses to the public comments. Seven sets of
17 comments were received by a diverse selection of
18 industry groups. NEI, NUGEQ, IEEE, BWR Owners Group,
19 Westinghouse, TVA, and Exelon.

20 Each of the public comments was addressed,
21 and the responses made publically available in ADAMS,
22 and the accession number's given here. For this
23 presentation, I'll highlight the significant comments
24 and describe the effect on the final guide.

25 Public comments associated with regulatory

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1 position one, voluntary conversion to Rev 4 for
2 current plants. One comment recommends that the Reg
3 Guide should recognize the acceptability of a plant's
4 current licensing basis.

5 Another comment is there is an
6 unnecessarily restrictive requirement to convert the
7 entire plant's accident monitoring system to Rev 4.

8 Another comment addresses the draft guide
9 language that the Reg Guide being not intended for
10 current operating reactor licensees is confusing.
11 Another comment requests the Reg Guide to provide
12 guidance for performing digital upgrades.

13 And the final regulatory position now
14 states that it is intended for new nuclear power
15 plants. Public comments associated with regulatory
16 position number two, calibration during an accident.

17 One comment stated it was not clear that
18 the requirements are relaxed based on the standards
19 listed in the standard for maintaining calibration.
20 Another comment stated that calibration was only
21 required during post-event operating time and not
22 necessarily during the full accident duration. The
23 third comment requested additional relaxation by
24 changing maximum extent to extent practical. The
25 final regulatory position revised the term "maintain

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1 calibration" to "validate calibration."

2 Public comments associated with Regulatory
3 Position No. 3, Type C Variable Extended Range
4 Requirements. One comment recommends that extended
5 range requirements be addressed in Section 5.1 of the
6 IEEE Standard instead of Section 4.3. Another comment
7 requested the addition of current alternative source
8 terms into the Reg Guide. The regulatory position was
9 revised to reference 5.1 of the Standard.

10 Public comments associated with Regulatory
11 Position No. 4, Contingency Actions. One comment
12 stated that BWR Contingency Actions extend beyond the
13 design basis. Another comment stated there are no
14 limitations to the contingency actions considered.
15 Another comment stated that contingency actions are by
16 definition beyond design basis. Another comment was
17 to exclude design basis actions from contingency
18 action criteria. The regulatory position was revised
19 to recommend consideration of contingency actions
20 within the plant's licensing basis.

21 MR. KEMPER: This is Bill Kemper. If I
22 could just add this and again the operative phrase
23 there is "within the plant's licensing basis." So
24 what we were faced with here is certain licensees were
25 saying contingency actions should be off limits

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1 because they're not. But what we found was that's not
2 a unilateral interpretation within the industry. To
3 some, it's an NSSS type of term that's treated
4 differently within the NSSS community.

5 So our position again just to try to be as
6 clear as we can is we said we don't care what you call
7 the actions. You can call them contingencies,
8 operator actions. It doesn't matter. As long as
9 they're needed to combat an accident in a manner
10 that's within your plant's licensing basis, then they
11 should be included in Reg Guide 197 program.

12 MEMBER SIEBER: One of the difficulties
13 here is that depending on who the vendor was
14 Westinghouse, Combustion Engineering, General Electric
15 or what have you, BMW, the ERGs were written
16 differently. Some were accident-based, some were
17 symptom-based and because of that, at least one of the
18 owners groups went to what they called criteria safety
19 function procedures which to me sounds an awful lot
20 like all these contingency actions because you're
21 trying to solve the problem with the accident you
22 think you have.

23 On the other hand, somebody else, usually
24 the shift technical advisor, is looking at this
25 different set of instruments to make sure or to detect

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1 whether you're going outside the procedural boundaries
2 and into unanalyzed space. Those are the contingency
3 actions that I think you have to find. It would be
4 good to have instruments that actually work when
5 you're trying to maintain or restore safety functions.
6 So I really didn't have too much of a problem with the
7 staff's concept here.

8 MR. TARTAL: There were no public comments
9 against Regulatory Position No. 5, Number of Points of
10 Measurement. Public comments associated with
11 Regulatory Position No. 6, Reference, Codes and
12 Standards. The comment requested the Reg Guide to
13 allow the use of those codes and standards within a
14 current plant's licensing basis. The staff position
15 here is that a current plant voluntarily converts to
16 REV 4 should meet all of the applicable criteria for
17 that variable type and any necessary deviations
18 documented by the licensee will be reviewed the staff
19 and approved on a case-by-case basis. And that's
20 consistent with the current process of licensees
21 requesting deviations from REV 2 or REV 3. So there
22 were no changes to the regulatory position.

23 Position No. 7, Type C Variable Instrument
24 Duration. The comment requests the option for using
25 the licensing basis documentation as a source for Type

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1 C variable instrument duration. The staff
2 incorporated this option by adding the regulatory
3 position.

4 Public comments associated with Regulatory
5 Position No. 8, Clarification of Operating Time. You
6 will recall an earlier public comment regarding post-
7 event operating time versus full accident duration.
8 The staff position again is that operating time should
9 encompass the full accident duration. So the final
10 regulatory position modifies the term "post-event
11 operating time" to "operating time" and this
12 regulatory position was added as a result of the
13 comment.

14 In conclusion --

15 MEMBER MAYNARD: I'm sorry. Could I have
16 just a minute for Position 4 just for my own
17 understanding? I'm not challenging your position on
18 that, but licensing basis isn't always that clearly
19 defined. I want to have a little bit of discussion to
20 make sure we don't create an unintended consequence
21 here. I believe contingency actions are good and I
22 want to make sure this doesn't provide a disincentive
23 for plants to have contingency actions just so they
24 don't have to add programs and stuff. Can I get your
25 thoughts on that?

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1 MR. KEMPER: Let's see. Bill Kemper. Let
2 me give this a try. Contingency actions have a wide
3 variety of use. For example, one contingency action
4 could be that if both charging pumps don't start
5 automatically, then you start the third pump.

6 Another contingency action could be that
7 if you're in a beyond-design basis scenario and you
8 have significant core melt, then you need to run
9 cables from one MCC to another MCC because that's the
10 problem. You've lost power to half of your ECCS
11 cooling train. That's clearly, that last example is
12 clearly beyond design basis. That's severe accident
13 mitigation guidelines is what the CE community calls
14 it anyway. But the first is you're still trying to
15 stay within your design basis to mitigate a LOCA and
16 stay within your accident analysis. So that's the
17 problem that we're struggling with.

18 If we just carte blanche say all
19 contingency actions are out of balance as far as Reg
20 Guide 197 is concerned, then we may unintentionally
21 eliminate some indications that are needed for the
22 operators to perform those types of access.

23 MEMBER MAYNARD: And I understand and like
24 I said, I'm not challenging your position. I just
25 think we need to keep in mind going forward that we

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1 make sure we don't create a disincentive for having
2 contingency plans in place. We can always have them
3 in the back pocket.

4 MR. KEMPER: Absolutely. You are
5 absolutely correct. They are absolutely needed.

6 MR. TARTAL: In conclusion, Reg. Guide
7 197, REV 4 endorses the current industry standard,
8 IEEE Standard 497-2002, with exceptions and
9 clarifications. Public comments have been received
10 and staff responses are publicly available in ADAMS.
11 This revision is intended for new nuclear plants and
12 any current operating plant wishing to convert to this
13 criteria may do on a comprehensive and voluntary
14 basis. There are no back fit issues associated with
15 the revision. Now any final comments or questions?

16 MEMBER SIEBER: I guess I could make a
17 statement. I really studied this job thoroughly and
18 I did not detect any place where there was a technical
19 error either in the standard or in the staff's way of
20 handling it which eliminates one of the barriers
21 toward implementing a NUREG guide. So if there are
22 issues, in my own mind they are issues in how to
23 implement as opposed to whether it's technically
24 correct or not correct.

25 I thought the documentation, particularly

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1 the public comments, were thoughtful and I found the
2 staff's documentation of how their whole process of
3 going through this including resolution of public
4 comments is very well done. For me, it was easy to
5 read, understand what your thought process was and why
6 you made the decisions that you did. So overall I can
7 say that I think the staff did a pretty good job here
8 even though I may disagree with one or two minor
9 things, but overall very good. Well done.

10 MR. TARTAL: Thank you, Dr. Sieber.

11 MEMBER SIEBER: Any questions from
12 anybody?

13 MEMBER MAYNARD: I would second your
14 comments there. Again in reviewing this, it looks
15 like overall a very good job, a thorough job. May
16 still have some doubts as to the all or none but I
17 certainly understand pros and cons of that. I
18 certainly understand that that's something that
19 requires some more thought, but I do not disagree with
20 some of your concerns relative to that at all.

21 MEMBER SIEBER: Any other questions or
22 comments? If not, Mr. Chairman, I think we have
23 finished.

24 CHAIRMAN WALLIS: Finished.

25 MEMBER SIEBER: Wow. Thank you very much.

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1 CHAIRMAN WALLIS: We seem to be gaining
2 some time. I wonder if we could use the time to
3 discuss your reaction to this in the form of your
4 letter since it's on your minds.

5 MEMBER SIEBER: Okay.

6 CHAIRMAN WALLIS: As I understand it, we
7 are in general. Can we come off the record in that
8 case? Let's go off the record.

9 (Whereupon, the foregoing matter went off
10 the record at 9:17 a.m. and went back on the record at
11 10:18 a.m.)

12 CHAIRMAN WALLIS: Back on the record. The
13 next item on the agenda also concerns Jack Sieber who
14 will lead us through this matter, Evaluation of
15 Precursor Data to Identify Significant Operating
16 Events. Jack.

17 MEMBER SIEBER: Okay. Thank you, Mr.
18 Chairman. For those of you who have read the research
19 report which by now should be everyone at least in
20 draft form, you will note that in the operating
21 experience section I call Accident Scenario Precursor
22 in the Analysis of Operating Experience the keystone
23 of the Agency and the Agency couldn't function and do
24 its statutory obligations and enforce its rules
25 without insights that this program provides.

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1 So we're going to hear from the staff
2 today about their most recent analysis and compilation
3 of insights that they gained from examining operating
4 experience and this will be an information briefing.
5 Unless something startling and unbeknown to me occurs,
6 we do not plan to write a letter on this. On the
7 other hand, I'm hoping that all of us appreciate the
8 importance of this subject to the functioning of the
9 Agency.

10 MEMBER POWERS: I think we should look at
11 this carefully to see how we want to dampen those
12 words of high praise that you include in the research
13 approach.

14 MEMBER SIEBER: Well, I may be alone in my
15 opinion, but I will not change my mind.

16 MEMBER POWERS: I wanted to see you
17 explain to Mr. Diaz how we have asked and then we have
18 the Commission.

19 MEMBER SIEBER: That's right. You explain
20 that. What I would like to do now is introduce Pat
21 Baranowsky who is the Deputy Director for Operating
22 Experience and Risk Analysis to provide a few words of
23 introductions.

24 MR. BARANOWSKY: Thanks. Of course as you
25 know, the Office of Research just reorganized and I

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1 became the Deputy Director for that position and one
2 of our branches in there is the Operating Experience
3 branch which primarily has the role of analyzing data
4 for accident sequence precursors. The Acting Branch
5 Chief Doug Weaver is out because his wife just had a
6 baby. Normally the Branch Chief is Mike Cheok who I
7 think you all know and he'll be continuing to have a
8 significant role in the accident sequence precursor
9 analyses. I wanted to let you know that.

10 As you mentioned, the purpose is to come
11 and brief the Committee on what we've been doing over
12 the past year and we're pleased to be able to do that.
13 We'll talk about the status of the program, then the
14 trends and insights and a summary. That will all be
15 provided by Gary DeMoss who has been taking a
16 significant role in leadership in the analysis of the
17 accident sequence precursors.

18 Sorry. I mentioned that and are we about
19 ready to get to you, Gary?

20 MR. DEMOSS: Do you want me to do this
21 one?

22 MR. BARANOWSKY: I can't tell. What's the
23 next one? Just for historical purposes, we like to
24 put things like this into the record so folks can
25 remember what the Accident Sequence Precursor Program

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1 is. It's been around a long time. It was implemented
2 right around the time with Three Mile Island and it
3 has the primary objective to systematically evaluate
4 the operating experience, to identify and document
5 instances that have potential to lead to severe core
6 damage and have a high enough probability to be of
7 interest to us.

8 So it's a tool that rakes through the
9 operating experience information and points out the
10 most significant ones that we should focus on. It's
11 become a significant input to the Annual Performance
12 and Accountability Report in Industry Trends Program.
13 In fact, it was discussed by Jim Dyer at the
14 Regulatory Information Conference in his discussion on
15 Tuesday. The Program is also used to identify issues
16 that can have potential for generic communications or
17 study or generic safety issues.

18 And one other thing that is the last on
19 the list over here but I don't want to understate it
20 is the use of this program as a partial check on our
21 PRA models and feeding back into the SPAR models in
22 particular. But we've also had discussions with folks
23 from industry on various modeling issues that don't
24 seem to agree with results of accident sequences
25 showing significant sequences and the nature of

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1 scenarios. And I think this is the point where I turn
2 it over to Gary. So if it's not, I'm turning it over.

3 MR. DEMOSS: Okay. Some of the highlights
4 I think we're going to show in the presentation today.
5 Again for the record, I'm Gary DeMoss. We're going to
6 announce that the Fiscal Year 2003-2004 events are
7 substantially complete and the results were reported
8 in the SECY paper referenced throughout this
9 presentation. There were no significant precursors in
10 Fiscal Year 2003-2004 and we're far enough in Fiscal
11 Year 2005 to announce that there were no significant
12 precursors in that year.

13 The trend analysis, the major point we
14 want you to take out of the trend analysis, we'll
15 break this down quite a bit as we go through is that
16 there was no trend in the rates of occurrence of
17 precursors in the last ten years. You'll see some
18 mixed results and some interesting results in our
19 trending I hope, but there is certainly no increasing
20 trend in our higher risk precursors which I think we
21 have to consider good news.

22 First I'm going to --

23 MEMBER APOSTOLAKIS: Let me ask a question
24 here.

25 MR. DEMOSS: Sure.

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1 MEMBER APOSTOLAKIS: Your highlights are
2 based on the condition of core damage probability of
3 these precursors. It would be also of interest to see
4 not only from these three years but also from the past
5 whether there have been any precursors that if I look
6 at the PRA, the scenario that happened was not there,
7 in other words, the issue of the structure of the PRA
8 not just the probabilities. Are you guys monitoring
9 that? Are all these sequences of the precursors
10 included one way or another in the PRA and is it just
11 a matter of the probability or there may be some
12 insights regarding the actual logical models that the
13 PRAs are employing right now?

14 MR. DEMOSS: I don't think we've found
15 insights in the logical models. We've found and we
16 tabulate those, although I don't have a slide on it
17 today. We tabulate events that are not directly
18 covered in the PRA. But I think the structure of the
19 model, the mitigating systems, has been robust even in
20 just the SPAR models in certainly in a more detailed
21 PRA.

22 MEMBER APOSTOLAKIS: I mean this issue
23 came up also in the old days when TMI happened. The
24 question was did the reactor safety study have that
25 sequence. And of course at some level, the PRA always

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1 has it because if you go high enough to the system
2 level or even the functional level then of course it's
3 there. These are very broad events.

4 But I guess the actual way through which
5 something happens often times is not in the PRA and
6 the question is of course whether this is an omission
7 or you have to cut off the analysis at some point. I
8 mean, for example, the TMI accident was a small LOCA.
9 So in that sense, it was in the reactor safety study.
10 But the actual way it happened was not in the reactor
11 safety study and the question is whether that can be
12 declared as incompleteness of the analysis or
13 something that we know. The details of an actual
14 occurrence are not expected to be in the PRA. Right?
15 When you say the failure rate of a component, that
16 represents a class of possible ways that a component
17 can fail.

18 MR. DEMOSS: Right. It represents an
19 integral of all possible ways it can fail/

20 MEMBER APOSTOLAKIS: Exactly.

21 MR. DEMOSS: I guess one that comes to
22 mind now and it's not a real current one is a
23 condensate storage tank where we take into account
24 that it could fail to provide water. But we don't
25 take into account that it could fail to provide water

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1 due to junk floating in there. The PRAs are just not
2 that specific.

3 MEMBER APOSTOLAKIS: So we're in agreement
4 with that, but the question is whether at some higher
5 level we found something that should have been in the
6 PRA. I'm not talking about the detail of failure
7 modes. So you're saying no.

8 MR. DEMOSS: The ASP is not at a higher
9 level found that.

10 MEMBER APOSTOLAKIS: ASP what?

11 MR. DEMOSS: The ASP program has not found
12 anything at a high level that should be in a PRA, for
13 example, an operator action that was taken that
14 probably successfully solved the problem. I don't
15 think we've found anything that --

16 MR. BARANOWSKY: Gary, I think you're
17 actually -- If you go down a little bit, he's saying
18 the very top structure just as you said with the Watch
19 1400 Report has the sequences in there.

20 MR. DEMOSS: Yes.

21 MR. BARANOWSKY: But I think one, if I
22 recall, remember there was like an Event B type
23 sequence at, which plant was it, Waterford or Wolf
24 Creek or something. There was a drain.

25 PARTICIPANT: Wolf Creek.

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1 MR. BARANOWSKY: And you won't find that
2 sequence in any PRA that I know of. But it was one of
3 our significant findings and in fact it led to generic
4 communications and so forth and that's why I remember
5 it. So from that point of view, I think we've found
6 several where there are unique characteristics to the
7 sequence of events which we have either noted or tried
8 to accommodate into our models.

9 I don't know that every time they get into
10 a model, but they might just get into a generic issue
11 program because like with the Wolf Creek Event B, it's
12 pretty hard to come up with the scenarios for every
13 plant model without doing a very detailed analysis of
14 their maintenance and procedures which actually was
15 the cause of this situation. So I hope that --
16 Anyhow, we're trying to fold those back in either to
17 the models or make note of them and get them into
18 generic communications so they are covered in the
19 regulatory program.

20 MEMBER DENNING: Could I quickly check a
21 couple of things? As far as what you've identified as
22 a significant precursor, that is core damage
23 probability greater than 1×10^{-3} that's a cutoff that
24 you use to say it's significant or not significant.

25 MR. DEMOSS: Yes.

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1 MEMBER DENNING: That seems to me to be --
2 I would have gone lower to call significant
3 recognizing we have a number of precursors that happen
4 every year and certainly if we had the belief there
5 were things out there at 1×10^{-4} per year, for
6 example, and recognizing the uncertainties associated
7 with core damage probability, I would have put it
8 significant at a lower level. How much does that
9 impact?

10 MR. DEMOSS: We do track important
11 precursors. Also I think the definitions by nature
12 are arbitrary, but we certainly track it at each order
13 of magnitude level and important precursors are rare
14 and receive a tremendous amount of attention.
15 Significant precursor has Congressional reporting
16 requirements and what not attached to it.

17 MEMBER DENNING: Okay. So it's not that
18 you're not. It's just in a different category.

19 MR. DEMOSS: That's right.

20 MEMBER DENNING: And when you say the
21 higher risk precursors, that 1×10^{-5} , is that
22 actually the core damage frequency associated with
23 those?

24 MR. DEMOSS: Core damage probability.
25 Conditional core damage probability.

1 MEMBER DENNING: It is conditional. Now
2 let me see if I understand what you're saying there
3 then. We have a significant precursor at 1×10^{-3} .
4 You have higher risk precursors. That includes other
5 categories that are -- Higher risk is not more.

6 MR. DEMOSS: That's a loose term I put in
7 this overview slide. You'll see that we tabulate our
8 precursors in four different orders of magnitudes and
9 the top couple of order of magnitudes are greater than
10 10^{-5} and we don't get too many in there and we're not
11 getting more is all I'm saying here. The higher risk
12 is in small letters. It's not a well defined --

13 CHAIRMAN WALLIS: This is just arbitrary
14 names for categories.

15 MEMBER DENNING: This is just arbitrary.
16 Yes, but I thought higher risk was more scary than
17 significant, but maybe it was just the words are
18 confusing.

19 CHAIRMAN WALLIS: You're arguing about the
20 word.

21 MEMBER APOSTOLAKIS: Significant is the
22 scariest.

23 MEMBER DENNING: That's the scariest.
24 Significant is scarier than higher risk.

25 MEMBER APOSTOLAKIS: In fact you report

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1 this to the public. Right?

2 MEMBER DENNING: That's okay.

3 MR. DEMOSS: Yes. To Congress and the
4 public.

5 MEMBER DENNING: Okay. That clarified it.
6 Thanks.

7 CHAIRMAN WALLIS: Higher risk is greater
8 than high risk. It does sound a little bit as a wrong
9 word to use.

10 MR. BARANOWSKY: Gary, maybe I can help
11 out here. I think the term "significant" should
12 actually have quotes around it and what he means
13 "higher risk precursors" he means higher than the ones
14 that are lower.

15 CHAIRMAN WALLIS: Yes.

16 MR. BARANOWSKY: As opposed to being a
17 category. It's a little bit of a semantics theme.

18 MR. DEMOSS: I think that will be little
19 clearer as we go through some of the tabulations and
20 graphics later.

21 MEMBER APOSTOLAKIS: Maybe you can call it
22 intermediate instead of higher.

23 MEMBER DENNING: That's okay.

24 MR. DEMOSS: Another new term but yes,
25 that would work. All right. Before we go into the

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1 trending and the levels of risk in detail, I'm going
2 to mention some of the recent ASP program
3 accomplishments and give a report on the status of the
4 program.

5 Some of the major things we've done
6 recently are we finished the Davis-Besse, the final
7 Davis-Besse, ASP analysis in March of last year and
8 we've completed essentially all of 2004 precursors
9 with a couple of issues that aren't entirely
10 dismissed. We're well along in the preliminary
11 assessments of all of the FY '05 events. I think
12 we've identified all of them and are in the process of
13 generating packages for that.

14 We completed the SECY last year which was
15 a greatly expanded study of trends and insights
16 compared to previous annual SECY reports and hopefully
17 we'll find this useful. I think we'll take it one
18 step further here in the near future and maybe clarify
19 a few things and I think it's a useful exercise.

20 We've completed a trial application of an
21 expert elicitation methodology and issued the Palo
22 Verde.

23 MEMBER APOSTOLAKIS: Expert opinion.
24 You're not eliciting the experts. You are eliciting
25 their opinion. This is a word that is needed there.

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1 MR. DEMOSS: Okay. And we'll talk about
2 that in a little more detail in a future slide. And
3 we've tried to reduce some of the burden of NRR and
4 region and licensing reviews of lower risk events by
5 streamlining our review process in a risk-informed
6 manner and that was approved by management in December
7 2005.

8 MEMBER APOSTOLAKIS: Now do we have the
9 ASP analysis for Davis-Besse? Have we seen this?

10 MEMBER DENNING: Yes, I think we did.

11 MR. DEMOSS: It's been presented to
12 subcommittee in detail and certainly publicly
13 available and that sort of thing.

14 MEMBER APOSTOLAKIS: What is it, a NUREG?

15 MR. DEMOSS: No, it's simply an ASP
16 analysis. It was announced on the website much more
17 aggressively than normal.

18 MEMBER DENNING: I didn't know we
19 definitely had a presentation on it.

20 MR. DEMOSS: You had a series of
21 presentations of the ASP analysis and that led a
22 request of the presentation for the metallurgical
23 analysis which is really ground-breaking work and that
24 was given you the last, the ASP analysis was given
25 last spring and the metallurgical work was given by

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1 Mark Kirk in the fall I believe, November.

2 MR. THORNSBURY: Yes. It was late summer.
3 Last year at this time, we had Gary and his group do
4 this same presentation and that included a portion of
5 it, specifically on Davis-Besse which led us to ask
6 for the follow-up.

7 MEMBER APOSTOLAKIS: Can you get me a copy
8 of the analysis?

9 MR. THORNSBURY: Yes. That's easy.

10 MEMBER APOSTOLAKIS: But how does one
11 account for cultural issues? You accounted for those.
12 You don't have to tell me the details.

13 MR. DEMOSS: Cultural issues?

14 MEMBER APOSTOLAKIS: I mean yes. Davis-
15 Besse was a major failure of safety culture.

16 MR. DEMOSS: I mean we have procedures to
17 the fact of that in specific human actions. We
18 measure what we observe to happen. We don't predict
19 whether it will happen again or not. I think a safety
20 culture study would go a long way toward procedure.

21 MEMBER APOSTOLAKIS: So you use SPAR-H.

22 MR. DEMOSS: You can factor a culture in
23 some ways into the SPAR-H.

24 MEMBER DENNING: But the thing is all of
25 those cultural things led to not identifying. Where

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1 they started was you had such and such a condition, a
2 physical condition, and from that point on --

3 MEMBER APOSTOLAKIS: Right. It's
4 conditional on what happened.

5 MEMBER DENNING: Yes.

6 MR. DEMOSS: Okay. The current status of
7 the ASP analysis is tabulated here. I think
8 interestingly you can see we had around 20 of actual
9 precursors identified each of the last few years and
10 you can see the status of actually completing an issue
11 in these precursors tabulated here. The notes will
12 explain that some analysis of CRDM events are still
13 lagging behind because we don't have a real good
14 method to quantify them. In previous years, the ASP
15 team would have categorized these as impractical to
16 analyze and not attempted them. We're still working
17 and making some progress and hope to finish those this
18 spring.

19 Just as a note to tell you, in addition to
20 the precursors identified, the ASP program actually
21 does a full risk analysis of 20 to 50 events and finds
22 that they are less than 1×10^{-6} in conditional
23 probability and we use the term "rejects these
24 analysis" from the actual publication on the counts of
25 these ASP analyses.

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1 All right. 2004. I picked what I think
2 are the more interesting analysis and actually a
3 significant percentage of our analysis count is going
4 to be covered on this page and if you bear with me a
5 minute, I would like to talk a little bit about each
6 event. The first one we have here is a grid LOOP of
7 Palo Verde. In fact, it was a good deal of the
8 southwest portion of the United States.

9 MEMBER SIEBER: That's the one with the
10 bird.

11 MR. DEMOSS: That's the one with the bird.

12 MEMBER SIEBER: Okay. I won't describe
13 that in any more detail.

14 MR. DEMOSS: No, I don't have a slide on
15 the bird itself. We focused on phalange and what we
16 had was a grid LOOP complicated by a couple of breaker
17 failures in the switch yard at Palo Verde and diesel
18 failure on Unit 2. The dominant sequences we got on
19 Unit 2 were the seal LOCA following a station blackout
20 leading to core damage.

21 MEMBER POWERS: Just is it an unavailable
22 diesel generator or a failure?

23 MR. HUNTER: It started with -- failed to
24 load.

25 MEMBER POWERS: So it wasn't --

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1 MR. DEMOSS: Which in risk term, again I
2 apologize for the jargon.

3 MEMBER APOSTOLAKIS: It failed. I'm
4 sorry. Let me follow that. When did it failed?

5 MR. DEMOSS: It failed shortly after the
6 start, after it started.

7 MEMBER DENNING: It didn't synchronize or
8 something.

9 MR. DEMOSS: It wouldn't synchronize but
10 it didn't work.

11 MEMBER DENNING: It didn't work.

12 CHAIRMAN WALLIS: It does stop though.

13 MEMBER SIEBER: No -- away.

14 CHAIRMAN WALLIS: It couldn't connect in
15 some way.

16 MR. DEMOSS: Yes. I don't have a great
17 deal of details on the diesel failure. Chris is the
18 analyst.

19 MR. HUNTER: I have the analysis in front
20 of me. Chris Hunter. Essentially it failed to load
21 after receiving the starter signal and they couldn't
22 maintain the voltage and operators actually tripped
23 the diesel. It turned out to be a failed diode.

24 CHAIRMAN WALLIS: So it was an electrical
25 problem. It wasn't a diesel problem.

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1 MR. HUNTER: Yes.

2 MEMBER KRESS: What are the three numbers
3 in parentheses?

4 MR. DEMOSS: The three numbers in
5 parentheses, I was heading to, are the actual
6 conditional core damage probabilities for the three
7 units.

8 MEMBER KRESS: Three different units.

9 MR. DEMOSS: Right. There are three units
10 at Palo Verde. Units 1 and 3 had a 90^{-6} because their
11 diesels were successful and Unit 2 with the one failed
12 diesel had a 4×10^{-5} and I was saying the 4×10^{-5} was
13 actually dominated by the possibility of going to
14 station blackout, in other words, having the other
15 diesel fail and a seal LOCA would probabilistically
16 lead to a likelihood of core damage. The dominant
17 sequences on the two plants without a failed diesel
18 were actually the LOOP followed by an early failure of
19 the auxiliary feed water system which is again fairly
20 common for a LOOP analysis that both of these are.

21 Another relatively high risk and
22 interesting analysis was some voids in the suction
23 piping also at Palo Verde unit and this is the ECCS
24 suction that they would use to go into piggyback
25 recirculation. A significant amount of air was found

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1 in the suction piping and of course reported to the
2 NRC. The licensee did a great deal of analysis and
3 determined that for the relatively low flow rate
4 through the system following a small LOCA that the
5 piggyback recirculation definitely would not work.

6 The licensee after analysis using scale
7 models and laboratory work and then extrapolating said
8 that the system would most likely work for a medium
9 LOCA because the flow rates were high enough. The NRC
10 Thermal, Hydraulic and Fluids guys took a look at this
11 and said maybe, maybe not but unfortunately your
12 modeling is not adequate to prove it would work. So
13 no credit was given for that working and the SDP
14 actually did their analysis assuming that failure of
15 recirculation in a medium LOCA. The SDP came out with
16 a mid 10^{-5} conditional core damage probability.

17 The ASP analysis decided to take, since we
18 were already working on an expert elicitation of
19 opinion process, we decided to try this process on the
20 pump experts. Excuse me. I should said the fluid
21 flow experts I guess on either side of this issue and
22 this is not a full blown expert elicitation panel. We
23 don't have the resources to do that on ASP analysis.
24 This only takes the system experts a couple of hours
25 to go through this process and a few more hours for

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1 the person putting it on.

2 MEMBER APOSTOLAKIS: That's okay. The
3 NUREG that was issued several years ago has different
4 categories of expert opinion elicitation processes and
5 clearly says for many problems you don't have to go to
6 the full blown approach. That's fine and what you're
7 doing is fine.

8 MR. DEMOSS: Right.

9 MEMBER APOSTOLAKIS: This is not an issue
10 of national importance in which case you would need to
11 assemble experts from all over the world and so on.

12 MR. DEMOSS: Exactly. We tried to come up
13 with a focused and defensible analysis useful for an
14 ASP analysis. I want to make that clear for people
15 not familiar with it that it was not --

16 MEMBER MAYNARD: Was one of the things
17 that drove this number up the length of time that the
18 condition had existed?

19 MR. DEMOSS: Yes.

20 MEMBER MAYNARD: Because it had existed
21 for --

22 MR. DEMOSS: It did. By structural rule,
23 an ASP only looks at a year duration for a problem
24 like this, but it indeed had existed not for the life
25 of the plant but way back toward the beginning of it.

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1 MEMBER MAYNARD: Pretty close to it, yeah.

2 MR. DEMOSS: So this expert elicitation of
3 opinions is a systematic process to create a
4 probability distribution for this, in this case,
5 failure of the function necessary for recirculation
6 and we did this and came out about a factor of three
7 lower than what the SDP had done who conservatively
8 and necessarily with their time frames that they had
9 assumed that the high pressure recirculation function
10 would not work in medium LOCA.

11 MEMBER APOSTOLAKIS: Do you mean they had
12 the probability of one and you had something like 0.3?
13 Is that what you're saying?

14 MR. DEMOSS: That's correct.

15 MEMBER DENNING: Yes. I have some concern
16 about the use of expert elicitation panels in lieu of
17 conservative analysis in this type of situation. I
18 think that there are times when we have, and it could
19 be for practical purposes in some cases, where you
20 might have to fall back to expert elicitation panels.
21 But I think that it is fraught with issues in that one
22 only falls back on it when you really have to. That's
23 my personal opinion.

24 I think that it's so easy to elicit and I
25 know that there are ways that one sets it up, stuff

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1 like that. But I think we could really fool ourselves
2 if we fall into in my perception a trap of going the
3 easy route of expert elicitation panels in that for
4 things like ASP I think that it doesn't hurt to be a
5 little conservative and really challenge whether we
6 want to push further on something. So I just hate it
7 when we have to fall back on expert elicitation panels
8 myself.

9 MEMBER SIEBER: Actually that points out
10 a problem that I see with PRAs where the state of the
11 art could be improved and it's something that the
12 staff might want to think about. Anytime that you
13 have a failure of a piece of equipment and a PRA is
14 either operable or it's failed and it doesn't take
15 into account the concepts like margin where something
16 may not meet all of the criteria but somehow or other
17 it does or it can operate and this would be a long
18 term kind of a thing because it would be very
19 difficult to try to model in to a PRA the concept of
20 margin.

21 But I think that sort of addresses what
22 we're talking about here as far as the Palo Verde
23 incident. There probably was some margin there.
24 There is a couple of ways to deal with it. One of
25 them is to be conservative and say it failed and you

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1 get a number. And another one is to ask your friends
2 which would be the expert panel and what number do you
3 want and put that number in there or to try to do some
4 kind of analysis that says I have this much margin and
5 therefore even if I don't meet all of the conditions,
6 it's likely to be successful.

7 MEMBER BONACA: But if you have, in PRA,
8 you have evidence that you have margin you assume in
9 fact that it will operate. I think here it's a unique
10 regulatory application of PRA that has to contain some
11 conservative. So probably that's what skews some of
12 the assumptions here, but typically if you have the
13 basis for concluding that the equipment will operate
14 even if it is not operable by definition, regulatory
15 definition, you will assume that.

16 MEMBER SIEBER: It's sort of like the
17 concept of containment overpressure. Some plants,
18 it's allowed and other plants, it's not allowed.

19 MEMBER APOSTOLAKIS: The major as we all
20 know, the way the regulatory system treats
21 uncertainties is two-fold. One is the extensive use
22 of redundancy. That structure is different.

23 MEMBER SIEBER: Right.

24 MEMBER APOSTOLAKIS: And other is large
25 safety margins. The PRA really deals only with

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1 redundancy issues. There is an major impediment in
2 trying to do what you suggest which I think is
3 reasonable and that is you have to have a good
4 evaluation of the uncertainties in the thermal
5 hydraulic calculations. So what they're resorting to
6 now is the vendor gives us the results.

7 If this temperature is below this, it's
8 okay and they do the redundancy of the calculations
9 and they say it's okay or it's not okay. But in an
10 ideal world if you had a distribution of that
11 temperature and you would calculate your own
12 temperature, then it's an easy thing to find the
13 probability that the stress is greater than the
14 strength. But this is the major impediment. We tried
15 to do something like that a few years ago and
16 immediately you hit a wall.

17 MEMBER SIEBER: It's a very difficult
18 problem.

19 MEMBER APOSTOLAKIS: You hit a wall
20 because you don't even -- This Agency probably has the
21 tools, but smaller organizations no.

22 MEMBER SIEBER: Well, I would be -- For
23 example, if you take a power up-rate before the
24 uprate, everything is supposed to work and you have
25 these failure probabilities. Now you do an uprate,

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1 use some of the margin that you have, but the failure
2 probabilities don't change. So you do a pre-uprate
3 PRA and a post uprate PRA. Nothing changes except the
4 operators have to move it a little faster and that to
5 me is not the right application.

6 MEMBER APOSTOLAKIS: This Committee is on
7 record urging the staff or recommending not urging
8 that some quantification of the margins would be
9 useful.

10 MEMBER SIEBER: I think so.

11 MEMBER APOSTOLAKIS: But I'm not sure that
12 there is a major effort to do that.

13 MEMBER SIEBER: Yeah. Well --

14 MEMBER APOSTOLAKIS: This goes way beyond
15 what these guys are doing. We're talking about
16 something --

17 MEMBER SIEBER: We talked about a couple
18 of things in PRA space. One of them is dealing with
19 margin and how we model failure, component failure, is
20 the other one. It has to do with the previous
21 question which was do we model all the phenomenon and
22 no matter if you had an infinite amount of time and
23 infinite amount of analysts, there would always be one
24 out there that thinks you did a model. On the other
25 hand, these are areas of improvement of the process I

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1 think.

2 MEMBER APOSTOLAKIS: In some areas
3 actually it is being done, for example, the evaluation
4 of the probability of failure of the containment under
5 certain accident conditions. People do resolve to
6 this method that I mentioned. You know they have a
7 distribution for the strength of the containment.
8 They calculate the uncertainties and the severe
9 accident results. But this is an exception. It's not
10 the rule, especially one PRA. It's exactly what you
11 are complaining about. It's always yes/no.

12 MEMBER SIEBER: Yes. I suspect we've
13 spent enough time on that and I've gotten my feelings
14 out.

15 MEMBER APOSTOLAKIS: That's a good
16 suspicion.

17 MEMBER SIEBER: But maybe we can just
18 continue on.

19 MR. TARTAL: Okay. I appreciate that.
20 Another interesting event that occurred in '04 was the
21 LOOP at St. Lucie following Hurricane or during
22 Hurricane Jeanne. They attributed the cause of the
23 LOOP to salt spray on the switch yard. Of course, no
24 one was out there to verify it because indeed they
25 couldn't go out there for many hours and that had a

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1 big effect on our analysis because we don't know at
2 what point, if their diesels had failed, their diesels
3 did not fail, at what point they would have gone out
4 there and verified the switch yard was safe and we
5 also don't know exactly when that switch yard became
6 operable. So we did our best from licensee reports.

7 Another interesting thing that comes out
8 of this analysis which incidently was dominated like
9 Palo Verde with the short term failure of auxiliary
10 feed more so than the longer term station blackout
11 sequences, but I think one thing that's important in
12 this analysis is the way we gave the licensee credit
13 for their pre hurricane shutdown procedures. We used
14 the operating model, at-power PRA model for this
15 analysis, but actually the licensee was shut down and
16 cooled down to 350 degrees or so.

17 In doing that, they make things a lot
18 simpler and some of the things we assumed is that
19 they've removed the possibility of an early relief
20 valve lifting, they're down below the transition
21 temperature for an RCP seal LOCA and by removing these
22 possibilities from the operating model, I think we
23 give them a fair shake and a fair credit for their
24 pre shutdown procedures which looking at it roughly
25 reduces the risk by an order of magnitude.

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1 MEMBER APOSTOLAKIS: So you did this
2 because St. Lucie doesn't have a PRA for shutdown?

3 MR. TARTAL: The shutdown PRA is actually
4 not as good a tool for a recently shutdown plant as
5 the operating model because you do have steam. You do
6 have steam for your auxiliary feed. You do possibly
7 if you heat up you can maybe even bypass your MSIVs
8 and steam to the secondary plant. So the plant really
9 is going to behave more like modeled in the operating
10 model than in the low power shutdown model some
11 several hours after shutdown.

12 MEMBER APOSTOLAKIS: That's very
13 interesting. So maybe we should stop asking for
14 shutdown PRA.

15 MR. TARTAL: I beg to differ because the
16 work gets rather exciting and we can't handle that
17 with an operating model.

18 MEMBER SIEBER: Or come up with a new
19 class "recently shut down."

20 MEMBER APOSTOLAKIS: Recently shut down.

21 MR. TARTAL: Another interesting analysis
22 we had in '04 was the Calvert Cliffs trip and a
23 potential for an over-cooling transient. The reactor
24 tripped on a relatively common loss of main feed
25 situation but a relay failure caused them to lose

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1 control of their atmospheric dump in turbine bypass
2 valves.

3 MEMBER SIEBER: They stayed open.

4 MR. TARTAL: And therefore they did have
5 excessive cool down and a safety ejection. They shut
6 their MSIVs and successfully recovered the plant, but
7 if an MSIV had failed, they would have had some
8 significant core damage sequences to deal with. This
9 is interesting for a couple reasons. One, our SPAR
10 models and many licensee PRAs have stopped modeling
11 over-cooling sequences because in the base case of the
12 PRA, you don't get a risk that shows up. But we
13 actually got a bit of a risk and had to dust off and
14 remodel those scenarios to address this ASP event.

15 MEMBER BONACA: How did the cool-down
16 happen? I know the loss of main feedwater.

17 MR. TARTAL: The loss of main feedwater
18 lower generator level as you'd expect and aux feed
19 came on and that sort of thing, but the K-7 relay I
20 believe it was caused both the atmospheric dump and
21 the turbine bypass valves to stay open and to not run
22 back to a more closed position as it should have.

23 MEMBER BONACA: So you kept feeding.

24 MR. TARTAL: So we kept feeding and
25 cooling down and again, the operators that did see

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1 what was happening took control of that. And we're
2 not looking at anything in the upper range of
3 precursors. We're looking at a mid 10⁻⁵ event here.

4 MEMBER APOSTOLAKIS: Good.

5 MR. TARTAL: Moving on and we'll have to
6 go through this a little more quickly because we
7 really can't talk about work in progress too much but
8 I thought I'd highlight some of the things we're
9 working on fiscal year 2005 and we'll be able to speak
10 about in more detail at a future date, we have a
11 flooding vulnerability out there that's received
12 considerable analysis. We had single failure
13 vulnerabilities announced, identified, early in FY '05
14 due to meters that actually tap into both safety buses
15 at a number of plants and these are some obscure
16 failure modes that theoretically can de-energize both
17 safety buses at a power plant and it's a difficult
18 quantification exercise.

19 We've had a number of initiating events
20 throughout the year. We've had trips complicated by
21 problems with low voltage power, problems with RCIC,
22 leakage in the primary plant and some safety valve
23 issues. Additionally, we've had LOOPs complicated by
24 hurricane and relatively minor equipment failures.

25 MEMBER APOSTOLAKIS: So this is now again

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1 coming to my favorite theme of structural changes. In
2 PRAs in general, we do not consider the concurrent
3 existence of two initiated events. Isn't that right,
4 Pat?

5 MR. BARANOWSKY: Two?

6 MEMBER APOSTOLAKIS: Of two initiated
7 events?

8 MR. BARANOWSKY: Not unless they are
9 correlated somehow.

10 MEMBER APOSTOLAKIS: But the LOOP was an
11 example of the hurricane.

12 MR. BARANOWSKY: Yes, it should have been
13 as a result of the hurricane.

14 MEMBER APOSTOLAKIS: If it's the result,
15 you're right.

16 MR. BARANOWSKY: Yes. But sometimes --

17 MEMBER APOSTOLAKIS: I thought that there
18 was already a loss of power and then the hurricane
19 hit.

20 MR. BARANOWSKY: But a LOOP could result
21 in a safety relief valve opening and staying stuck.
22 So you would have loss of oxide power plus loss of
23 coolant, but they are correlated through the model.

24 MEMBER APOSTOLAKIS: Do we account for
25 these?

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1 MR. BARANOWSKY: We account for that.

2 MEMBER APOSTOLAKIS: We is not us. We is
3 the PRA community.

4 MR. BARANOWSKY: The PRA community
5 accounts for it as a result of things that were done
6 many years ago.

7 MEMBER APOSTOLAKIS: Yes.

8 MR. DEMOSS: Additionally, we're
9 exercising really for the first time our shutdown
10 models on several events right now. The models
11 haven't been widely used and so we got in opportunity
12 to use it on events that occurred on a solid plant and
13 mid LOCA event.

14 CHAIRMAN WALLIS: What's a solid plant?

15 MR. DEMOSS: No bubble in the pressurizer
16 to PWR.

17 CHAIRMAN WALLIS: That's right.

18 MEMBER SIEBER: Charge it a little bit and
19 the pressure goes.

20 MR. DEMOSS: Yes. Now we're going to step
21 away from the events and talk about the trends covered
22 in the SECY paper for the next several slides.

23 MEMBER APOSTOLAKIS: So Davis-Besse was a
24 precursor in FY 2002.

25 MR. DEMOSS: That's correct.

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1 MEMBER APOSTOLAKIS: And we have the
2 perennial problem now. You said earlier that it was
3 completed when?

4 MR. DEMOSS: With the final, it was the
5 preliminary analysis was developed to the public and
6 the licensee in 2004 and the final analysis in 2005,
7 March 2005.

8 MEMBER APOSTOLAKIS: Why does it take so
9 long?

10 MR. DEMOSS: Well, that question varies
11 for the specific case of Davis-Besse we needed a
12 significant amount of laboratory work and modeling to
13 come up with the probability of the head failing. It
14 didn't fail. It did not cause a LOCA and the
15 Metallurgic worked quite hard and spent quite a bit of
16 money.

17 MR. BARANOWSKY: That's a good example of
18 what happens when you do these detailed analyses to
19 support. We did some early analyses and got in the
20 ballpark, let's say, without having done that, but it
21 was a very important event for the Agency. So we
22 spent the time and effort on it and it takes that much
23 time to do these models.

24 MEMBER APOSTOLAKIS: And the detailed
25 analysis was significantly different from your early

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1 back-on-the-envelope calculation?

2 MR. BARANOWSKY: The probabilistic results
3 were not a lot different but I think the understanding
4 was much better than one could get.

5 MEMBER APOSTOLAKIS: Absolutely. The
6 earlier statement of expert opinions are not always
7 pretty good.

8 MR. THADANI: No, I think, George, there
9 were some significant issues that came out. The staff
10 had to do some experimental work as a matter of fact
11 to really understand what implications there were in
12 terms of both pressure loading and the timing. But
13 the effects if the plant had stayed operational for
14 eight more months, what would have happened? And
15 these issues were pretty important to understand.

16 MEMBER APOSTOLAKIS: I don't doubt that.

17 MR. THADANI: So a lot of it was because
18 a fair amount of experimental work had to be done
19 before one could really analyze.

20 MEMBER APOSTOLAKIS: And this, I guess,
21 was another example of maybe a new complete nuclear
22 threat. I mean this was medium-sized LOCA in a
23 location that had not been analyzed before.

24 MR. BARANOWSKY: It's one of these cases
25 where you have a medium-sized LOCA in the PRA, but

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1 there are some unique characteristics to it.

2 MEMBER APOSTOLAKIS: Not in that location.

3 MR. BARANOWSKY: Right. And by the way,
4 we had known this was going to be a significant
5 precursor for a long time. So it was always carried
6 on the books as that, but we wanted to wait until the
7 detailed analysis ASP said because we knew there were
8 some implications to the more detailed analysis
9 results of the metallurgy.

10 MEMBER APOSTOLAKIS: But this is a kind of
11 unique event and we all know that.

12 MR. DEMOSS: Yes.

13 MEMBER APOSTOLAKIS: But as you know,
14 there has been criticism in the past that you guys are
15 slow in producing the results. Is that still correct?

16 MR. THADANI. Yes.

17 MR. BARANOWSKY: We're proceeding down in
18 a catch-up plan -- Thank you, boss.

19 MR. THADANI: No, you had a correction
20 plan to deal with that issue, Pat.

21 MR. BARANOWSKY: And every time we want to
22 speed it up, we're told speed it up, do it quickly but
23 also put in horrendous amounts of details in the
24 nonprobabilistic risk models such as thermal
25 hydraulics or mechanical aspects.

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1 MEMBER APOSTOLAKIS: Okay. So those are
2 the things that hold us up.

3 MR. BARANOWSKY: So those are the things
4 that hold us up.

5 MEMBER APOSTOLAKIS: The moment you said
6 -- I know it's slow.

7 MEMBER SIEBER: The quick way is just do
8 a sine of failure probability of one and look at the
9 mitigating system response and you come up with a
10 pretty good approximate answer. You can do that
11 during lunch.

12 MR. BARANOWSKY: We do that to screen
13 events. We do that to screen the event and then we'll
14 also take a look at what we think are the realistic
15 ranges and if the ranges are such that you're going to
16 draw some different conclusions, we have to do the
17 more detailed analysis.

18 MEMBER SHACK: But the difficulty here
19 really wasn't getting the probability of the LOCA
20 itself. I mean once you had the LOCA, it was just
21 another medium-break LOCA, wasn't it? The real
22 difficulty was in deciding what the probability of the
23 LOCA was.

24 MR. DEMOSS: Actually the medium LOCA was
25 pretty much just another medium-break LOCA because

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1 it's not a bad place to have one. But we were
2 complicated by the sump and the HPI pump problems that
3 co-existed at Davis-Besse.

4 MEMBER SIEBER: On the other hand since
5 you're looking at failures probability per year and
6 you calculate that it take three months for the thing
7 to fail, you get the same answer either way. Right?

8 MR. DEMOSS: Pretty much.

9 MEMBER ARMUO: In your analysis, did you
10 ever come up with an estimate of when this thing would
11 actually fail?

12 MR. DEMOSS: The metallurgist did and
13 actually presented that and if I recall, it was a
14 median of five months and then a bounds of two to 12.
15 Is that correct? Again, I'm not the metallurgist.

16 MR. THADANI: Yes, that's correct. It was
17 I believe two months to 12 months with a median of
18 five or six months, something like that.

19 CHAIRMAN WALLIS: So this was at Davis-
20 Besse?

21 MR. DEMOSS: Yes, Davis-Besse.

22 CHAIRMAN WALLIS: So a metallurgist was
23 predicting how fast the hole was growing?

24 MR. DEMOSS: Yes.

25 CHAIRMAN WALLIS: I thought that was a

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1 thermal/hydraulic/chemical phenomenon.

2 MR. DEMOSS: He was supported by it.

3 CHAIRMAN WALLIS: He was supported. Okay.

4 MR. DEMOSS: But there was a quite few
5 people. There was a team of people working on it.

6 MEMBER SIEBER: But there were still some
7 simplifications in the calculations. Go ahead.

8 MR. DEMOSS: Okay. Other things. The
9 importance of SECY 05-R192 was that we had four
10 precursors that we call important precursors greater
11 than 1×10^{-4} and that includes Davis-Besse and then
12 a potential common mode failure of the aux feed system
13 at Point Beach. This is I believe a Mode 2 or 3 event
14 and then another potential common mode failure of AFW
15 Point Beach after they fixed the initial one and
16 didn't do that correctly. Again, those analyses have
17 been submitted and reviewed and those are the major
18 ones in the last few.

19 As I stated early on, there has been no
20 trend in the rates of occurrence of all precursors.

21 MEMBER APOSTOLAKIS: Excuse me, Gary. Can
22 you define trend here? How do you use the word
23 "trend"?

24 MR. DEMOSS: We measure it statistically
25 with a P value. I'll have a slide on that I believe

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1 the next slide.

2 MEMBER APOSTOLAKIS: Don't give me your
3 statistics. Tell me what it means. Is that from Dave
4 Raspinson? The P value?

5 MR. DEMOSS: Yes. It means we're not
6 finding more precursors than we were in the 1990s on
7 a 1993 to 2004 trend. There is a lot more information
8 in this precursor count and count by risk that we're
9 going to talk about, but the top level measure is no
10 significant trend.

11 MEMBER APOSTOLAKIS: So they're occurring
12 randomly. That's what you're saying.

13 MR. DEMOSS: I think we break it down and
14 show that they're really not quite occurring randomly.
15 We just don't have a significant trend in the count of
16 precursors.

17 MR. BARANOWSKY: Gary, why don't you just
18 in the interest of time just move right along to that
19 because I think you're just saying what you're going
20 to say.

21 MR. DEMOSS: Okay.

22 CHAIRMAN WALLIS: By trend, you look at it
23 as is it increasing or decreasing. You don't look for
24 some kind of a frequency or anything.

25 MR. DEMOSS: The final bullet on this

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1 slide really describes some pictures down the road.
2 So we'll talk about that when we get to some figures.

3 MEMBER APOSTOLAKIS: You have some
4 figures. Yes.

5 MR. DEMOSS: Some figures on that.

6 MEMBER APOSTOLAKIS: Yes.

7 MR. DEMOSS: First, we do mention the
8 trending approach that we use consistently and we do
9 measure a P value which quite simply is a standard
10 statistical measure to look at the probability of
11 random data looking at the trends. So low P value
12 means that it's not likely to be random data. And we
13 start our trending around 1993 because that's when we
14 started using our own SPAR models for ASP.

15 Just to support that trending in '93,
16 first I want to show you a long term history from 1984
17 to current of the number of precursors per year and
18 '92 and before we had quite a few more. I don't know
19 what we exactly attribute it to. I think it's far
20 enough in the past that I don't think it's important
21 that we trend there. So the dataset that we're
22 actually going to do our --

23 MEMBER APOSTOLAKIS: Is it you may fit --

24 MR. DEMOSS: Yes sir. We might.

25 MEMBER BONACA: But I think especially in

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1 recent time with the SPAR model pretty accurate as you
2 have, your ability of evaluating precursors has
3 improved tremendously. I mean in the '80s it was a
4 much rougher models that you used. Right?

5 MR. DEMOSS: Yes sir. Much rougher.

6 MEMBER BONACA: So that really is a
7 contributor to that.

8 MEMBER APOSTOLAKIS: So what you're
9 saying, Mario, is that there is combination of reasons
10 here. First, we may indeed further decrease getting
11 better or whatever, but also our analytical abilities
12 have improved.

13 MEMBER BONACA: Absolutely. Yes.

14 MEMBER APOSTOLAKIS: Although this '03
15 areas are sore to the eye.

16 MR. DEMOSS: We'll look at '03. This is
17 just a blow-up of the right side of the previous
18 chart. We're going to trend these events from 1993 to
19 2004 and again as I stated previously, if you take
20 this picture as a whole and try to calculate a trend,
21 your statistics tell you that it's not a trend.

22 MEMBER APOSTOLAKIS: Let me understand
23 this. Does the P value reflect only the existence of
24 a trend that is monothermic?

25 MR. BARANOWSKY: Yes. This is pure

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1 straight line trending. If someone tried to do a best
2 bit, I think you would see a trend that looked like a
3 smile on that curve.

4 MEMBER APOSTOLAKIS: So if it goes up and
5 down and up down, then the P value would not be
6 represented here.

7 MR. BARANOWSKY: He's saying a straight
8 line trend.

9 MEMBER APOSTOLAKIS: It will not be.

10 MR. BARANOWSKY: It will not be, yes.

11 MR. DEMOSS: This is a slope of zero.

12 MR. BARANOWSKY: It depends on the model
13 and are you going to tell them about some of the
14 investigation that we did to see what's going on in
15 2000?

16 MR. DEMOSS: Right. I want to focus on
17 that. The fact is it's a linear trend. We don't have
18 an increase or a decrease going on here and I think
19 that's what I want you to take out of it.

20 MEMBER APOSTOLAKIS: Maybe you should make
21 that explicit because no trend identified is kind of
22 too general for the ability of this method to identify
23 behavior.

24 MEMBER POWERS: It is very frequently
25 observed in econometric data that there is serial

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1 correlation in the results. That is the discrepancy
2 between the linear correlation. One year is positive.
3 The next year will also be positive to a high degree
4 of probability. Do you look for serial correlations
5 here and if you do look for serial correlations, do
6 you attempt to revise your linear model to accommodate
7 that serial correlation?

8 MR. DEMOSS: The answer is we don't look
9 at that deep. We start looking for logical or an
10 engineering reason for what we're seeing rather than
11 try to take our statistics to that advanced level.

12 MEMBER POWERS: The econometricians find
13 value in trying to, because they so frequently find as
14 you might imagine and they tend to do quarterly data,
15 sometimes even monthly but definitely quarterly data,
16 that one quarter is bad, the next quarter is better
17 and things like that and they find value in doing an
18 analysis of the serial correlation. I wonder if there
19 might be some value here because, yes, they do a
20 mechanical manipulation of the statistics and what not
21 but then they try to interpret what is that telling
22 them.

23 MR. DEMOSS: I see what you're looking for
24 and maybe would identify some activity at the NRC that
25 was having an effect on the correlations or something

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1 like that. But we haven't tried to go that deeply and
2 I'm not sure the amount and type of data would really
3 support that.

4 MEMBER POWERS: It may not. Your data is
5 clearly not as dense as their data.

6 MR. DEMOSS: Right. We're talking about
7 20 events a year.

8 MEMBER POWERS: That's not beyond the
9 pail. Often times, they do it. But I will admit.
10 Your data is not as dense as the econometricians get
11 to work with.

12 MEMBER KRESS: If you did what you were
13 saying you would perhaps attach more significance to
14 that 1996 on the previous curve

15 MEMBER POWERS: You might or actually I
16 would expect it to be that you would not attach such
17 great significance to 1997.

18 MEMBER KRESS: Yeah.

19 MEMBER POWERS: Okay. I'm guessing but my
20 guess would be that they would go that way.

21 MR. DEMOSS: Okay. This is a set of
22 figures that we present annually. I think they are
23 useful figures that gives a top level look at what
24 we're seeing in the ASP program. First, we look at
25 the top left, the precursors in the 10^{-3} bin, the

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1 significant precursors and we don't see a measurable
2 trend in that. We only see three over the 12 or so
3 years that we're looking at.

4 For the 10^{-4} bin, we see on the average of
5 about one per year in precursors in this case in the
6 10^{-4} bin and you see a decreasing trend here. They
7 tend to bunch up in years because you often have like
8 our Point Beach example the same issue at multiple
9 plants and that does count as two precursors because
10 there is risk.

11 CHAIRMAN WALLIS: There's really not a
12 decrease. Take away the first point. If you take
13 away the first point, there isn't a trend. So it's
14 not really that significant.

15 MR. DEMOSS: Possibly so. For
16 consistency, we stuck with 1993. I don't think we see
17 an increase which is actually the important result
18 though.

19 MEMBER KRESS: What are the vertical lines
20 on the curve?

21 MR. DEMOSS: The vertical, that's the
22 uncertainty of the curve. The next bin is again not
23 showing an increase or a decrease and that's
24 precursors in the 10^{-5} bin and as you can see, we get
25 five or so a year of those. So they are not

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1 particularly rare and when you put them in bins like
2 this, we do see an increase in the number of
3 precursors in the 10^{-6} bin which is the lower of the
4 bin, the much more commonly occurring bin. That's
5 something we'll look at down.

6 MEMBER APOSTOLAKIS: Now the 10^{-6} rise
7 there, I suspect that has to do more with the
8 analytical capabilities than actual time. I mean the
9 analyses keep becoming more detailed and better with
10 the years. Right?

11 MR. DEMOSS: I'd like to think so. Yes.

12 MEMBER APOSTOLAKIS: Yes, so maybe --

13 MEMBER DENNING: Do you think it's driving
14 them down?

15 MEMBER APOSTOLAKIS: Driving them up.

16 MEMBER DENNING: Well, I don't know.

17 MEMBER APOSTOLAKIS: Ten to the minus six.

18 MEMBER DENNING: Or maybe it's taking
19 events that would have been --

20 MR. DEMOSS: I'm going to show you on the
21 next couple slides what I think is driving that and
22 that's not what we concluded. But we can talk about
23 it. Let's do that in a slide or two.

24 MEMBER SHACK: How could the analysis have
25 anything to do with events?

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1 MEMBER APOSTOLAKIS: This is just
2 occurrence or this is their ASP.

3 CHAIRMAN WALLIS: It depends on how you
4 calculate the numbers.

5 MEMBER APOSTOLAKIS: How you calculate the
6 numbers.

7 MEMBER POWERS: You take a conservative
8 analysis at the 10^{-4} event and you take a realistic
9 analysis at the 10^{-6} event. It's the same event.

10 MEMBER APOSTOLAKIS: It should be going
11 the other way.

12 MEMBER DENNING: No, I agree with Bill's
13 assessment.

14 MEMBER SIEBER: Or you just rethink your
15 failure probability data.

16 MR. DEMOSS: All those things are going on
17 certainly and that affects the trend and it makes it
18 difficult to measure. We did trending in a couple of
19 periods. We looked at '93 and 2004 period and then we
20 looked closer at the 2001 to 2004 period which makes
21 us suffer from sparse data since it's only four years.
22 But I think it's an important four years.

23 The reason that's an important four years
24 is kind of two-fold and I think we try to pick them up
25 in the bullets. There is an evolution of the methods

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1 and our capabilities to use the SPAR models on complex
2 conditions. In past years, ASP just wouldn't take on
3 some of these more difficult, unusual events that
4 weren't fairly straightforward and applicable to the
5 tools and that's going to include shutdown events as
6 we start doing more of those.

7 And the other and probably larger effect
8 is that the ASP has always screened LERs, will always
9 continue to screen LERs. We have never been a primary
10 screener of inspection reports. The SDP has picked up
11 a fair number of events that don't have LERs and put
12 any time the SDP comes up with a greater than green
13 finding ASP for a mitigating system cornerstone event,
14 ASP automatically picks that up.

15 So what I'm doing with this slide is I
16 wanted to find a rebaselining we did to normalize that
17 criteria to look at just the events that ASP would
18 have picked up if we didn't have an SDP and we'll use
19 that for some of our graphics and data analyses in the
20 next couple of slides.

21 At the 10^{-4} and above level, that would
22 have been the top two bins of that four graph page,
23 none of this is doing anything and I think the reason
24 is we weren't and we never have been missing events in
25 the 10^{-4} range and they've always gotten serious ASP

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1 analysis. If you look at the FY 1997 to 2004, you see
2 the ASP program scope is increasing and you measure an
3 increasing trend in the number of events. But if you
4 remove a couple of chunks of events from this
5 rebaseline data and those two chunks are the CRDM
6 events which is about ten events that occurred and
7 were discovered in 2002-2003 time frame with all the
8 head cracking and the eight LOOPs that occurred on one
9 day in August 2003, the trend significantly flattens
10 out.

11 I guess the other thing we're going to
12 show here in the next couple graphs is that of course
13 we don't have to rebaseline the 2001-2004 events. We
14 just don't show any trends yet partially because it's
15 scarce data, partially because I don't think there are
16 any trends in the recent data.

17 We did a variety of other looks at our
18 precursor data that we have, described them in great
19 detail in the SECY and I'm just running through the
20 high points right now. We looked at the frequency of
21 initiating events occurring versus the frequency of
22 ASP analyzing degraded conditions. We're getting more
23 and more degraded conditions we're finding and that's
24 consistent with the theory that SDP aggressive
25 analysis of events is identifying more events for the

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1 ASP program.

2 MEMBER SIEBER: How do you know it's not
3 a reflection of the so-called bathtub theory in aging
4 plants, the older the plant gets the more events
5 you're going to have?

6 MR. DEMOSS: That's something we would
7 like to address in the future. We have not found a
8 way or dreamed up a way to mine that out of this data
9 but it's something that is a good question.

10 MEMBER SIEBER: I think it's key to what
11 are the things we're doing these days.

12 MEMBER APOSTOLAKIS: About how many -- I
13 mean surely you see whether some of these failures are
14 due to aging effects, don't you?

15 MR. DEMOSS: That information is available
16 to us. ASP's primary goal is to measure the risk of
17 the event as it occurred and we're not the cause and
18 correction engineers. So it's there but we're not --

19 MEMBER SHACK: But in just your one, the
20 CRDM events are clearly aging events. The LOOP events
21 are not.

22 MR. DEMOSS: I wouldn't say 100 percent
23 without looking, but I think you're right.

24 MEMBER APOSTOLAKIS: Or it's the aging of
25 something else that we don't regulate.

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1 MR. DEMOSS: Right. Ceramic insulator
2 aging is another issue. I'm not prepared to speak on
3 that or investigate that right now.

4 MEMBER SIEBER: The growth in the system
5 load is an aging issue. If the system capacity stays
6 the same and the load increases, the margin disappears
7 and you add more LOOPS.

8 MR. DEMOSS: If we were to analyze aging
9 with ASP, we would need a concise definition and I'm
10 not sure which side of that definition your phenomenon
11 should be on.

12 MR. BARANOWSKY: Gary, the scope of the
13 work normally is to determine if there is an
14 increasing trend and then there is an Agency program
15 to go and look at the why part. That's the Agency
16 Trending Program that's run by NRR and although we
17 might contribute to that discussion, they're really
18 the ones who figure out if it's aging or whatever.

19 MEMBER SIEBER: Okay. Thank you.

20 MR. DEMOSS: Okay. Again you've had a
21 presentation on LOOP initiating events from Dr.
22 Raspinson of our branch and our statistics do like his
23 show a significant increasing trend on LOOP-ASP events
24 which is not identical to the number of LOOPS during
25 this '93 to 2004 time frame and it would not be

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1 statistically significant over that long time frame if
2 it were not for the August 14, 2003 grid issue.

3 Another trend we've noticed is that BWR
4 precursors are showing an increasing trend while PWR
5 precursors do not show an increasing trend and we
6 basically were unable to come up with a why on that.

7 MR. HUNTER: The BWR trend is strongly
8 influenced by the LOOPS. If you take out the LOOP
9 events, there is no trend for the BWRs.

10 MR. DEMOSS: Okay.

11 MEMBER APOSTOLAKIS: Can you explain that
12 a little more?

13 MR. HUNTER: Sure. We actually had very
14 few LOOP events especially during the 1997 through
15 2001 period for BWRs. We don't know exactly why but
16 as you see in the overall total precursor trend, the
17 BWR trend is strongly influenced by the Northeast
18 blackout where five BWR events. That's five
19 precursors right there. You also had Peach Bottom.
20 You had a few other. Dresden, no not Dresden, but you
21 had a couple other LOOP events in there. So you're
22 not talking about a lot of data and you're talking
23 it's back-loaded on 2003 and 2004 with LOOP events and
24 that's what's causing the increase in trend in the
25 BWRs.

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1 CHAIRMAN WALLIS: Presumably steam dryer
2 events never become safety significant enough to show
3 up on this.

4 MR. BARANOWSKY: That's a good assumption.
5 I don't recall a steam dryer event in ASP, but I've
6 only been in it since '03.

7 CHAIRMAN WALLIS: Is that so? Do the
8 steam dryer events not show up on this?

9 MR. BARANOWSKY: I can just tell you that
10 they're not in there. I don't know if it's a good
11 assumption. I'm a new kid on the block, but there
12 would be --

13 CHAIRMAN WALLIS: I look to you as knowing
14 everything.

15 MR. BARANOWSKY: I've been trained on
16 thermal hydraulics for the last 18 months. So now I
17 can go back and look at that.

18 MR. DEMOSS: Okay. The final part of our
19 analysis of events is a look at some indices that we
20 calculate to give us a comparison to the risk majored
21 in PRAs in general and we have two ASP indices. We
22 have an annual ASP index which assigns all the risk of
23 an ASP event to the year it occurred and normalizes it
24 to the reactor operating time and to take a look at
25 some ASP events that actually were designed

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1 deficiencies that existed since either beginning in
2 the plant life or early in the plant life. We've come
3 up with a new index to show that.

4 This is an index we've been reporting for
5 a long time that is the total risk calculated ASP
6 analyses divided by the reactor years of operation
7 that year and it shows that ASP core damage
8 frequencies is generally calculated to below $1E^{-5}$
9 which is in the same general ballpark as where the
10 risk models are. It also shows that significant
11 precursors put a big bump on this when one does occur
12 and you can see the Davis-Besse being the most
13 prominent feature of this graphic.

14 MEMBER APOSTOLAKIS: What is a Δ CDP?

15 MR. DEMOSS: Δ CDP is the change in core
16 damage probability over the time in which an anomalous
17 condition exists at a plant.

18 MEMBER APOSTOLAKIS: Change. Is it on the
19 figure somewhere?

20 MR. DEMOSS: Right. They are added in
21 with the actual conditional core damage probability
22 following initiators.

23 MEMBER APOSTOLAKIS: So show us on the
24 figure. Where could I look at that?

25 MR. DEMOSS: They are both added in

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1 together and normalized by dividing the reactor years
2 for each year. But they could be separated but
3 they're not.

4 MEMBER APOSTOLAKIS: I don't understand
5 that.

6 CHAIRMAN WALLIS: They're added together.

7 MEMBER APOSTOLAKIS: You have the total
8 CCDP --

9 MEMBER SHACK: The number you get is that
10 total divided by the number of reactor years. That's
11 what he's applying.

12 CHAIRMAN WALLIS: But there are no
13 separate --

14 MEMBER APOSTOLAKIS: So CCDP is the
15 condition of the probability of core damage given the
16 condition. Right?

17 MR. DEMOSS: No, conditional core damage
18 probability is the probability of a plant given the
19 initiator.

20 MEMBER APOSTOLAKIS: That's what I said.
21 Given the condition. Given the --

22 MR. DEMOSS: Okay. We use the word
23 "condition" as "initiator condition."

24 MEMBER APOSTOLAKIS: Okay. Condition.

25 MR. DEMOSS: We use the word "condition"

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1 to --

2 MEMBER APOSTOLAKIS: So you find that to
3 be 10^{-4} . Then for the same event, what is the Δ CDP?

4 MR. DEMOSS: There isn't one. We don't do
5 a Δ CDP for the same event. We would do a Δ CDP for we
6 inspected Plant X and found that the RCIC pump was
7 unable to respond for the last several months. It was
8 therefore nonfunctioning.

9 CHAIRMAN WALLIS: There is no initiator.

10 MR. DEMOSS: So it's a conditional core
11 damage probability that if an initiator, what the
12 increase in core damage probability if an initiator
13 had occurred during the time that pump was
14 unavailable.

15 MEMBER APOSTOLAKIS: So why is it not a
16 CCDP? It is a CCDP.

17 MR. DEMOSS: It is another conditional
18 core damage probability calculated differently.
19 Correct.

20 MEMBER APOSTOLAKIS: It's just that it
21 includes the occurrence, the probability of the
22 occurrence, of the initiator over that period.

23 MR. DEMOSS: Right.

24 MEMBER APOSTOLAKIS: But it is a CCDP.

25 MR. DEMOSS: And with the time to

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1 multiply.

2 MEMBER APOSTOLAKIS: I don't think you
3 should call it a Δ CDP. It's CCDP under different
4 conditions.

5 MEMBER KRESS: You have to add it up for
6 all precursors.

7 MEMBER APOSTOLAKIS: Sure.

8 MEMBER KRESS: So it's not conditional
9 given precursor. It's this total Δ CDP.

10 MEMBER APOSTOLAKIS: But it's all CCDP.
11 It's not delta. That's what confusing me.

12 MEMBER KRESS: It's not conditional
13 though.

14 MEMBER APOSTOLAKIS: It's conditional on
15 the events that have been observed.

16 MR. DEMOSS: It is conditional on the
17 events. The Δ CDP we actually subtract out, during the
18 period of time, we subtract out the core damage
19 probability that existed, the baseline if you will,
20 that existed if that RCIC pump would have been
21 operable at its nominal failure probability during
22 that period of time.

23 MEMBER KRESS: Those type of things you
24 can't really add together, George.

25 MEMBER APOSTOLAKIS: Because the

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1 conditions are different.

2 MEMBER KRESS: Yes.

3 MR. DEMOSS: The answer is -- Dale, do you
4 want to take that one on, whether you can have CCDPs
5 and CDPs?

6 MR. RASMUSON: Sure. For those events
7 that involve a reactor trip where you have an
8 initiator, the base case would be zero in that case.
9 So the difference would be the CCDP that you
10 calculate. Whereas when you have a condition or an
11 unavailability event, we calculate the base case and
12 then you analyze the model for the event itself and we
13 subtract the difference between them. So in reality,
14 the calculations are the same for both of these
15 things.

16 MEMBER APOSTOLAKIS: But you have to
17 address the distinction between the two, but I think
18 the issue now is let's say you only have CCDPs for
19 simplicity.

20 MR. RASMUSON: Okay.

21 MEMBER APOSTOLAKIS: And you have five of
22 them. These are all conditional on different
23 conditions.

24 MR. RASMUSON: Right.

25 MEMBER APOSTOLAKIS: So what is the

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1 meaning of the sum when you really add them up?

2 CHAIRMAN WALLIS: It's a measured total
3 change in risk.

4 MEMBER APOSTOLAKIS: But it's different
5 conditions.

6 MEMBER KRESS: It's not total. You have
7 to somehow weight it by the frequency --

8 MEMBER APOSTOLAKIS: Yes. You have to
9 weight it by the probability of the frequency of the
10 condition that would materialize.

11 MR. BARANOWSKY: No.

12 MEMBER APOSTOLAKIS: Why not?

13 MR. BARANOWSKY: No. What you're doing is
14 you're saying in essence let me assume that all the
15 core damage risk was due to the plant being in the
16 state associated with the precursor and nothing else.
17 And then add all those up because risk doesn't come in
18 some uniform manner. For instance, diesel generators
19 work quite well over some period of time and then they
20 fail. So that's when you're at your highest risk. In
21 theory if you add these up over a long enough period
22 of time in case, each one being like a little
23 experiment, you're getting a total that would over
24 time equal approximately the total core damage
25 probability.

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1 MEMBER APOSTOLAKIS: Let me give you an
2 example. Suppose that you have a coin that has failed
3 and you calculated the probability of seven heads out
4 of ten tries. Then you have another coin that has
5 heads on both sides and you calculate the probability
6 of seven heads in ten tries. Now if you add those
7 two, what on earth are you getting? Nothing.

8 MR. BARANOWSKY: I don't think that's the
9 same thing.

10 MEMBER APOSTOLAKIS: It is the same thing.
11 You're adding conditional probabilities that have
12 different conditions. One is a double-sided coin.
13 The other is --

14 CHAIRMAN WALLIS: But you're measuring a
15 risk to the public, aren't you, in both cases and
16 you're adding them up?

17 MEMBER APOSTOLAKIS: But as Tom says,
18 these are conditions on different things. You have to
19 weight them.

20 MR. BARANOWSKY: Why would you be able to
21 add up all the core damage probabilities and divide by
22 the number of reactors to get an average core damage
23 probability?

24 MEMBER APOSTOLAKIS: Because they aren't
25 condition.

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1 MR. BARANOWSKY: Okay. Let's just do this
2 thought experiment and forget the coins and go to
3 nuclear power plants and let say that that issue now
4 is a diesel generator was taken out of service at
5 Plant A and a pump was taken out of service at Plant
6 B and thrown in the garbage. Redo the PRA and they
7 did it for one year. Redo the PRA and tell me can you
8 add those two together to get the average for those
9 two plants.

10 The answer is yes. That's all you're
11 doing. You just have a new in essence model over a
12 one year period of time that has a different
13 availability of key systems and the reason it's called
14 conditional is because the condition is those systems
15 were in some state that didn't allow them to
16 contribute in some manner to the reduction in risk.

17 MR. RASMUSON: This is Dale Rasmuson. But
18 you have the conditional probability. If you take the
19 weight that you're going to be and if you set it equal
20 to one, then the sum becomes an upper bound on the
21 true probability that you're going to get.

22 MEMBER KRESS: That's a better answer. I
23 like that.

24 MR. BARANOWSKY: Okay. That's a
25 statistician.

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1 MEMBER KRESS: I'll buy that.

2 MR. BARANOWSKY: That's why we work
3 together.

4 MR. RASMUSON: But the idea of index,
5 George, as you know, started from a paper that you and
6 Ollie put together on a use for this.

7 MEMBER APOSTOLAKIS: Then it's okay.

8 MEMBER SIEBER: Moving on.

9 MEMBER APOSTOLAKIS: I see. Yes.

10 CHAIRMAN WALLIS: Do you remember that
11 paper, George?

12 MEMBER APOSTOLAKIS: It's all right now.

13 MR. DEMOSS: I think this slide sums up
14 what we've discussed on this particular index and I
15 guess the limitations, the first bullet, the
16 limitations talks about the relationships and the SPAR
17 statistics and the fact that we do screen out events
18 less than 10^{-6} and we don't know theoretically whether
19 there's a million of them or five of them. And
20 additionally, the SPAR models only cover internal
21 events. So all these are only internal event risk.

22 The second index that we've begun
23 preparing this past SECY paper has the same issues
24 with conditional core damage probabilities and in fact
25 when we were totally it, I didn't differentiate

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1 between the two conditional core damage probabilities.
2 That's fine. We've had that discussion. But we did
3 take the risk that existed for a long period of time
4 and applied it to previous years. So this is not a
5 trend decrease that you're looking at on the graph at
6 all. It's just the fact that you don't have any post
7 2004 years to add risk to 2003 and 2004. So please
8 don't look at this as a trendable index at all, but it
9 does show the importance of long term risks and the
10 importance of detecting them and correcting them.

11 MEMBER BONACA: So, for example, 1993, we
12 envision this long term because of conditions. That's
13 because they didn't know at that time, but you still
14 counted them.

15 MR. DEMOSS: Right. We still calculated
16 that.

17 MEMBER BONACA: But there may be some
18 other conditions we haven't discovered yet.

19 MR. DEMOSS: That's right and that's why
20 you're seeing low -- We hope not, but you're right.
21 There might be and that's why we'll always expect to
22 see low bars in 2003 and 2004, the most recent years,
23 because by 2003 we have all the Point Beach and D.C.
24 Cook conditions that we know about corrected.

25 MEMBER BONACA: Yes. All I'm saying okay,

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1 but in the future, we may find that there were other
2 plants having other conditions and they would adapt
3 here in this case.

4 MR. DEMOSS: Yes sir.

5 MEMBER BONACA: And they'll bring up a --
6 however.

7 MR. DEMOSS: Absolutely.

8 CHAIRMAN WALLIS: This is a significant
9 message, isn't it? That there will be no trend in
10 most of the other figures, but this shows a
11 significant message that those things that are going
12 on for a long time and undetected have a significant
13 impact.

14 MR. DEMOSS: That's what I believe it
15 shows. Yes.

16 MEMBER SIEBER: From an industry
17 standpoint.

18 MR. DEMOSS: Right.

19 MEMBER SIEBER: What's the difference
20 between an ANSPAR and a regular SPAR?

21 MEMBER APOSTOLAKIS: I'm sorry. What?

22 MR. DEMOSS: In 2003, we did what I'll
23 call a significant enhancement in the 2002-2003 time
24 frame. We did some significant enhancements to the
25 SPAR models. Our data analysis reports that we used

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1 to quantify the SPAR models had lagged for a while.
2 So we redid those and updated all the component data.
3 We had Dr. Raspinson's Station Blackout study, so we
4 could requantify our LOOP and diesels from that
5 detailed study.

6 MEMBER APOSTOLAKIS: Who reviewed that?

7 MR. DEMOSS: And you reviewed that and we
8 also finished making, we also at the same time,
9 concurrently expanded the scope of the SPAR models to
10 really cover essentially all the initiators that the
11 licensee does.

12 MEMBER SIEBER: That change in level there
13 has nothing to do with the enhancement I presume. You
14 know the last two years are enhanced.

15 MR. DEMOSS: I think it does because when
16 we enhanced them we ended up with some lower risks
17 especially in the Station Blackout area.

18 MEMBER SIEBER: You should enhance it some
19 more. You should redrive the risk -

20 MR. DEMOSS: We're going for best
21 estimate.

22 MEMBER SIEBER: Just keep on enhancing.

23 MEMBER KRESS: I'm not sure I understand.
24 If you had something that existed for a long time
25 which increased the risk, why do you divide by the

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1 number of years? Why don't you multiple by number of
2 years?

3 MEMBER SIEBER: It's different every year.

4 CHAIRMAN WALLIS: No, he puts it in each
5 year.

6 MR. DEMOSS: In each year, we divide by
7 the number of reactor operating hours for that year
8 total for the nation.

9 MEMBER SIEBER: And that's why they're
10 different every year.

11 MR. DEMOSS: Although that's almost been
12 constant since 1993 and --

13 CHAIRMAN WALLIS: That's why the gray bars
14 are almost constant. It's the same thing being added
15 in each year, isn't it?

16 MR. DEMOSS: Right and in fact, a way to
17 look at that is the fact that the gray bar stays the
18 same height. That means that --

19 CHAIRMAN WALLIS: Right. Until you fix it
20 and then it goes down.

21 MR. DEMOSS: Right.

22 CHAIRMAN WALLIS: And as soon as you
23 discover something, they may all go up.

24 MR. DEMOSS: Correct.

25 MEMBER KRESS: I see.

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1 CHAIRMAN WALLIS: So the something may be
2 below the ground there waiting to emerge.

3 MEMBER KRESS: Oh yes.

4 MR. DEMOSS: Yeah. This doesn't show
5 that. It just shows the importance of finding these
6 long-term existing problems and correcting them.

7 MEMBER SIEBER: So it's either you find
8 them or they find you.

9 MEMBER KRESS: Thank you.

10 MR. DEMOSS: Okay. And I think again the
11 worst attributable, that chart, were covered. The
12 major feature is that it includes the risk of a
13 precursor for the entire duration of the condition.
14 As I explained, the initiating events only show up in
15 the year they occurred. I guess one thing I want to
16 say is Davis-Besse we only added risk to 2002 because,
17 yes, there was probably some risk before that but it
18 was a relatively rapidly aging thing and we weren't
19 going to spend more of the Agency's money to quantify
20 that.

21 CHAIRMAN WALLIS: How does this work with
22 something like some blockage thing? Suppose all these
23 screens are being fixed now.

24 MR. DEMOSS: Right.

25 CHAIRMAN WALLIS: Does this imply that

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1 some of those plants would have had blocked screens
2 had they had a LOCA in which case isn't that some
3 preexisting condition that should somehow figure into
4 this program?

5 MR. DEMOSS: Right now, that's out of the
6 scope of the ASP because it's not reported as a
7 deficiency.

8 CHAIRMAN WALLIS: It isn't but it's a
9 reality that might well exist and could exist.

10 MR. DEMOSS: I'm sure. We could apply
11 this sort of an index calculation to some screens.

12 CHAIRMAN WALLIS: But people haven't
13 actually evaluated that yet. But the fact that
14 they're replacing them with much bigger screens
15 indicates that there might well have been some
16 condition existing which needed to be corrected.

17 MR. DEMOSS: Yes. I'd hate to try to look
18 at that off the top of head.

19 MR. BARANOWSKY: Let me take a crack at
20 this a little bit. That's a generic issue and
21 normally what we should be doing is analyzing the risk
22 implications to do backfit for that and I don't know
23 if we plan to. But I know when we did Station
24 Blackout, for instance, we took a look completely
25 across industry and said "How much risk reduction do

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1 we expect at virtually each plant by going to that
2 rule" and we should if we do things the way we did
3 things in the old days do the same for sump. I'm not
4 saying we will, but if we have resources, that's the
5 way to do it.

6 CHAIRMAN WALLIS: So it's something you're
7 thinking about or at least you're aware you might be
8 doing.

9 MR. BARANOWSKY: Well, as it turns out,
10 now I have Generic Issues in my organization on top of
11 ASP. So yes, looking at it.

12 MEMBER MAYNARD: I think you would be
13 required to if the solution to the sumps required a
14 backfit. If the modifications are made without a
15 backfit, then I don't think the process automatically
16 requires you to do it.

17 MEMBER SIEBER: Well, the sump issue is
18 really a compliance issue. Is it not?

19 MEMBER KRESS: It's not a backfit.

20 MEMBER SIEBER: It's not a backfit, but
21 you're always supposed to have an operable sump. And
22 if you don't, you have to fix it and that's not a bad
23 thing.

24 CHAIRMAN WALLIS: Backfit or not, there
25 obviously would be appear to be some change in the

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1 risk in the plant by changing --

2 MEMBER KRESS: It would be of interest to
3 know -

4 CHAIRMAN WALLIS: It would be interesting
5 to know what it was.

6 MEMBER SHACK: -- did analyses of those
7 things.

8 CHAIRMAN WALLIS: And then it was changed
9 because there were all sorts of --

10 MEMBER SHACK: Yes, but then they
11 introduced the mitigating.

12 CHAIRMAN WALLIS: That's right.
13 Mitigating things, but the number they came up with
14 originally was too high. Okay.

15 MEMBER SIEBER: Last slide.

16 MR. DEMOSS: Yes. Finishing up this
17 slide, the important thing to take away from this is
18 as we've said the four long-term precursors really
19 contribute a lot of the total integrated average CDF
20 and any way you total it, those couple of long-term
21 precursors --

22 CHAIRMAN WALLIS: I guess that's why I'm
23 sort of thinking aloud here. If there are design
24 defects somewhere in the plant that have been going on
25 for a long time, there ought to be some way to catch

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1 those in this program too and not just the fact that
2 some left air in the pipes so the pump wouldn't work.
3 We know that's an operational error. But if someone
4 had designed the pipe line so that it wouldn't work,
5 and then it had to be fixed, that is an existing
6 design defect. Do you catch things like that?

7 MR. DEMOSS: Somebody else catches them
8 and we do the risk analysis is the answer.

9 CHAIRMAN WALLIS: Yes, but it has to
10 somehow get into your system.

11 MR. DEMOSS: That's right.

12 MEMBER SIEBER: A lot of these come in
13 through LERs.

14 MR. DEMOSS: Correct.

15 MEMBER KRESS: And normally, those kind of
16 things don't end up being events.

17 MEMBER SIEBER: Right.

18 CHAIRMAN WALLIS: But they are or they do
19 contribute to risk.

20 MEMBER KRESS: Oh, yes.

21 MEMBER SIEBER: Yes. Somebody's walking
22 through your plant and sees something and they said,
23 "I wonder why this is like this." And all of a
24 sudden, that comes in as an issue.

25 MR. DEMOSS: All right. And as a wrap-up

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1 slide, I'm just going to quickly go through what I
2 want you to take away from this. The first part was
3 ASP program status. We continue to evaluate the
4 safety significance of operational events. On the
5 issue of timeliness, we are in better shape than we
6 have been in previous years. We're preparing our 2005
7 events to support the Agency Action Review Meeting in
8 April.

9 MEMBER KRESS: Is that a new meeting? I
10 haven't heard about that. Have they had these before?

11 MR. DEMOSS: I'm not prepared to talk
12 about the history of that right now.

13 MR. BARANOWSKY: That's not a new meeting.
14 That's the one where the senior managers get together
15 and determine which plants are problems.

16 MEMBER KRESS: Oh, they just renamed it.

17 MEMBER SIEBER: Yes.

18 MR. BARANOWSKY: Yes. That's been at
19 least for a year or more like that.

20 MEMBER KRESS: Yes. Okay.

21 MR. DEMOSS: And here's the term you don't
22 like. The occurrence rate for higher risk precursors
23 which means the top couple bins is constant or
24 decreasing. The overall risk from ASP events is
25 relatively constant depending on how you look at it

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1 and trend it and the number of precursors we're
2 analyzing is higher now because of recent increases in
3 LOOPS which may or may not continue and the number of
4 events being identified by the SDP which I would
5 expect to continue.

6 That's the end of my prepared
7 presentation. I will turn it back to Dr. Sieber
8 unless there are more questions.

9 MEMBER SIEBER: Your timing is excellent.
10 I appreciate the presentation and I'm sure my
11 colleagues do also and I will reiterate that I think
12 this is an important work and vital to the Agency.
13 And with that, Mr. Chairman.

14 CHAIRMAN WALLIS: Thank you. Thank you
15 for getting through and just on time. Excellent. We
16 are going to take a break. We don't need the
17 transcript anymore. Thank you and we're going to take
18 a break until 1:00 p.m. Off the record.

19 (Whereupon, at 11:49 a.m., the above-
20 entitled matter was concluded.)
21
22
23
24
25

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
530th 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 Mollen
Official Reporter
Neal R. Gross & Co., Inc.



Regulatory Guide 1.97, Revision 4
“Criteria for Accident Monitoring Instrumentation
for Nuclear Power Plants”

Advisory Committee on Reactor Safeguards Meeting
March 10, 2006

George Tartal, I&C Engineer
Instrumentation and Electrical Engineering Branch
Division of Fuel, Engineering and Radiological Research
Office of Nuclear Regulatory Research
gmt1@nrc.gov 301-415-0016



OVERVIEW

- BACKGROUND
- REGULATORY GUIDE 1.97, REVISION 3
- IEEE STANDARD 497-2002
- REGULATORY GUIDE 1.97, REVISION 4
- PUBLIC COMMENTS AND STAFF RESPONSES
- CONCLUSION



BACKGROUND

- Instrumentation required to monitor variables and systems under accident conditions
 - 10 CFR Part 50, Appendix A, Criteria 13, 19, 64
- Reg Guide 1.97 Rev. 1 issued in August 1977
- Lessons learned from TMI
 - NUREG-0737
 - 10 CFR Part 50.34(f)
- Reg Guide 1.97 Rev. 2 issued in December 1980
 - Endorsed ANSI/ANS-4.5-1980
 - Implemented via NUREG-0737 Supp. 1
- Reg Guide 1.97 Rev. 3 issued in May 1983
 - Endorses ANSI/ANS-4.5-1980 (withdrawn and inactive)



REGULATORY GUIDE 1.97, REV. 3

- Each accident monitoring variable is assigned a variable type and a category
 - Variable type is selected based on function
 - Category is selected based on required quality level
- Organizes accident monitoring variables by variable type
 - Type A are for planned manual actions with no automatic control
 - Type B are for assessing plant critical safety functions
 - Type C are for indicating breach of fission product barriers
 - Type D are for indicating safety system performance and status
 - Type E are for monitoring radiation levels, releases and environs
- Design and qualification criteria applied by category
 - Cat 1 is for indicating accomplishment of safety function (~SR)
 - Cat 2 is for indicating safety system status (~AQ)
 - Cat 3 is for backup and diagnostic variables (~NSR)



IEEE STANDARD 497-2002

- Consolidates and updates criteria from ANSI/ANS-4.5-1980, IEEE Std 497-1981 and Reg Guide 1.97 Rev. 3
- Technology-neutral approach intended for advanced design plants
- Performance-based, non-prescriptive approach to accident monitoring variable selection
 - Prescriptive tables of variables are replaced by criteria for selection based on the accident mitigation functions
 - This is the most significant difference from Reg Guide 1.97 Rev. 3
- Selected variable type determines the applicable performance, design, qualification, display and QA criteria
- Categories are no longer used



IEEE STANDARD 497-2002 CRITERIA

- Selection
 - Defines variable types A, B, C, D and E and lists typical sources
- Performance
 - Range; Accuracy; Response Time; Duration; Reliability
- Design
 - Single & Common Cause Failure; Independence; Separation; Isolation; Power Supply; Calibration; Portable Instruments
- Qualification
 - Environmental; Seismic
- Display
 - Characteristics; Identification; Display Types; Recording
- Quality Assurance



REGULATORY GUIDE 1.97, REV. 4

- Responds to User Need Request NRR-2002-017
- Endorses IEEE Standard 497-2002 with exceptions and clarifications
- Intended for new nuclear power plants
- Conversion to the new criteria by current operating plants may be done on a comprehensive, voluntary basis
- Issued for public comment as DG-1128 in August 2005
- Eight regulatory positions



REGULATORY POSITIONS

1. How might current operating plants using Rev. 2 or 3 of Reg Guide 1.97 convert to IEEE Std 497-2002 criteria?
 - “The guidance provided in this standard may prove useful for operating nuclear power stations desiring to perform design modifications or design basis modifications.”
 - Some interest in applying Rev. 4 to current plants
 - IEEE Std 497-2002 provides no guidance in translating from type and category to type only
 - Generally: Type A,B,C = Cat 1, Type D = Cat 2, Type E = Cat 3
 - New criteria may be more or less stringent than existing criteria
 - The staff recommends conversion to be comprehensive and is strictly voluntary
 - Partial conversion could result in an incomplete analysis and is not endorsed



REGULATORY POSITIONS (cont.)

2. Calibration during an accident

- IEEE Std 497-2002 requires maintaining instrument calibration by means of recalibration, interval specification, equipment selection or cross-calibration
- Of these means, only recalibration can satisfy the requirement
- Modifies IEEE requirement to validating instrument calibration instead of maintaining instrument calibration

3. Severe accidents

- IEEE Std 497-2002 does not directly address severe accidents
- IEEE Std 497-2002 requires Type C variables to have extended ranges
- Clarifies the need for extended ranges based on current regulatory requirements



REGULATORY POSITIONS (cont.)

4. Contingency actions

- “Alternative actions taken to address unexpected responses of the plant or conditions beyond its licensing basis”
- IEEE Std 497-2002 excludes all contingency actions from the scope of potential Type A variables
- Applied as if all contingency actions are to mitigate accident conditions beyond the licensing basis of the plant
- Recommends considering all operator actions within the licensing basis during the selection process

5. Number of points of measurement

- IEEE Std 497-2002 does not address this topic, but was addressed in RG 1.97 Rev. 3
- Recommends the number of points of measurement be sufficient to adequately indicate the variable value



REGULATORY POSITIONS (cont.)

6. Codes and standards referenced

- Guidance is provided for references codified in regulations, endorsed in regulatory guides, or neither codified nor endorsed

7. Type C variable operating time

- IEEE Std 497-2002 requires at least 100 days operating time for type C variables
- Recommends an optional operating time as specified in the plant licensing basis

8. Replace “post-event operating time” with “operating time”

- The new language is consistent with the title change from “post accident monitoring” to “accident monitoring”
- Operating time should encompass the full accident duration



PUBLIC COMMENTS AND STAFF RESPONSES

Seven sets of comments received

- NEI
- NUGEQ
- IEEE
- BWROG
- Westinghouse
- TVA
- Exelon

Each comment has been addressed and responses made
publicly available in ADAMS

ADAMS accession number ML053640161

Only significant comments will be highlighted



PUBLIC COMMENTS AND STAFF RESPONSES

RP#1: Voluntary conversion to Rev. 4 for current plants

- Should recognize acceptability of plant's current licensing basis
 - Unnecessarily restrictive requirement to convert the entire plant's accident monitoring system to Rev. 4
 - "Not intended for current operating reactor licensees" language is confusing
 - Should provide guidance for performing digital upgrades
- RP#1 revised to clarify it is intended for new plants

RP#2: Calibration during an accident

- Not clear that requirements are relaxed
 - Only during post-event operating time
 - Change "maximum extent" to "extent practical"
- RP#2 revised "maintain" calibration to "validate" calibration



PUBLIC COMMENTS AND STAFF RESPONSES

RP#3: Type C variable extended range requirements

- Should address IEEE section 5.1 instead of section 4.3
 - Should add current alternative source terms
- RP#3 revised to reference section 5.1

RP#4: Contingency actions

- BWR contingency actions extend beyond design basis
 - No limitations to contingency actions considered
 - Contingency actions are, by definition, beyond design basis
 - Should exclude beyond design basis actions from contingency action criteria
- RP#4 revised to recommend consideration of contingency actions within the plant's licensing basis



PUBLIC COMMENTS AND STAFF RESPONSES

RP#5: Number of measurement points

- No comments

RP#6: Referenced codes and standards

- Should allow use of codes & standards within current licensing basis
- RP#6 not revised

RP#7: Type C variable instrument duration

- Should give option for use of licensing basis documents as a source for type C variable instrument duration
- RP#7 added as a result of this comment

RP#8: Clarification of operating time

- Post-event vs. full accident duration
- RP#8 was added as a result of this comment



CONCLUSION

- Regulatory Guide 1.97, Rev. 4 endorses current IEEE Standard 497-2002 with exceptions and clarifications
- Public comments have been received and staff responses are publicly available in ADAMS
- Intended for new nuclear plants, with current operating plant conversion on a comprehensive, voluntary basis
- No backfit issues
- Final Comments or Questions?



BRIEFING OF THE ACRS: EVALUATION OF ACCIDENT SEQUENCE PRECURSOR DATA TO IDENTIFY SIGNIFICANT OPERATING EVENTS

March 10, 2006

**Patrick W. Baranowsky, Deputy Director for Operating Experience & Risk Analysis
Douglas W. Weaver, Acting Branch Chief
Gary M. DeMoss, ASP Program**

**Operating Experience and Generic Issues Branch
Division of Risk Assessment and Special Projects
Office of Nuclear Regulatory Research
U.S. Nuclear Regulatory Commission**



Outline of Presentation

- Introduction & Background (P. Baranowsky)
 - Purpose
 - Highlights
- Program Status (G. DeMoss)
 - Progress of analyses
 - Recent events
- ASP Trends & Insights (G. DeMoss)
- Summary (G. DeMoss)



Purpose of the Presentation

- **To provide a brief overview of the status of the ASP Program**
- **To describe our analysis of trends in ASP-analyzed events**



ASP Program Background

ASP has been a part of NRC events analysis activities for about 25 years, and it has a variety of internal and external users.

- The primary objective of the ASP Program is to systematically evaluate operating experience to identify and document events likely to lead to core damage. Analyses are performed to define and project potential accident scenarios, determine risk exposure, and assess risk mitigation measures.
- ASP analyses are used to support:
 - Performance measures in the Annual Performance and Accountability Report to Congress
 - Industry trends program
 - Decisions to develop generic communications
 - Studies to determine the safety significance of potential regulatory issues
 - A partial check on PRA scenarios / SPAR models



Highlights of the Presentation

- Analysis of FY 2003 & FY 2004 events are substantially complete and included in the trend analyses
- No significant precursors (conditional core damage probability $\geq 1 \times 10^{-3}$) in FY 2003, FY 2004 or FY 2005
- No trend was identified in the rates of occurrence of all precursors during the period from FY 1993 through FY 2004
- Trending of precursors by bins yielded mixed results. There is no increasing trend in higher risk precursors ($>1 \times 10^{-5}$)



ASP Program Accomplishments

- **Final Davis-Besse ASP analysis issued in March 2005**
- **FY 2004 Precursors essentially completed in November 2005**
- **Preliminary assessments of all FY 2005 events will be available in Spring 2006**
- **Investigation of trends and insights completed in SECY-05-0192**
- **Trial application of expert elicitation methodology issued in Palo Verde analysis – awaiting comments (if any)**
- **Risk-informed review process implemented in December 2005**



Status of ASP Analyses

(as of February 28, 2006)

	FY-01	FY-02	FY-03	FY-04	FY-05
Total precursors identified^a	22	14	22	17	19
Final precursor analyses completed	17	10	20	14	0
Analyses not yet complete	5^b	4^b	2^b	3	19

- a) All of the reviews and analyses have not been completed, and therefore, the number of total precursors for these years may change
- b) Events involving cracking of control rod drive mechanism housings have not been completed, and therefore, the number of precursors attributable to cracking of CRDM housings may change

Note: The ASP program screens all LERs and rejects 20 to 50 events per year after performing risk analysis.



Interesting 2004 Analyses

- **Palo Verde LOOP (9E-6, 4E-5, 9E-6)**
 - Grid LOOP complicated with a breaker failure
 - Unit 2 had an unavailable EDG

- **Palo Verde ECCS Piping Voids (1E-5 per unit)**
 - SDP conservatively assumed that low pressure recirculation would not work for MLOCA
 - ASP used expert panel approach to create probability distribution for system operability – result consistent with SDP

- **St. Lucie LOOP during hurricane Jeannee (1E-5 per unit)**
 - Salt Spray on switchyard created uncertain recoverability
 - Full power model was adjusted to credit pre-hurricane shutdown procedures. (i.e., remove relief valve lift, RCP seal LOCA & some short term sequences)

- **Calvert Cliffs Trip and Potential Overcooling (5E-5)**
 - Reactor trip due to low SG level caused by loss of MFW pump
 - Relay failure causes excessive cooldown
 - SPAR models modified to include over-steam demand sequences



Potentially Interesting FY 2005 Analyses

- **Flooding vulnerability**
- **Single failure vulnerabilities due to metering relays**
- **Initiating events**
 - **Trips with complications related to low voltage power, RCIC, leakage & safety valves**
 - **LOOPs complicated by hurricanes and equipment failure**
- **S/D events with plants in vulnerable conditions**
 - **Solid Plant**
 - **Mid-loop**



ASP Results, Trends & Insights

Summarized from SECY-05-0192

- No *significant* precursors were identified in either FY 2003, FY 2004 or FY 2005. Davis-Besse was a significant precursor in FY 2002
- Four precursors identified in FYs 2002–2004 had a CCDP greater than 1×10^{-4} . Includes Davis-Besse, the potential common mode failure of AFW at Point Beach 1 & 2, and another potential common mode failure of AFW at Point Beach 2.
- No trend was identified in the rates of occurrence of all precursors during the period from FY 1993 through FY 2004.
- Trending of precursors by CCDP bins yielded mixed results. If a trend is considered statistically significant, it is very unlikely that the trend is a result of chance alone. Trending analysis of precursors in the CCDP bins yielded the following results:

● $CCDP > 1 \times 10^{-3}$	No trend
● $1 \times 10^{-3} > CCDP > 1 \times 10^{-4}$	Decreasing trend - statistically significant
● $1 \times 10^{-4} > CCDP > 1 \times 10^{-5}$	No trend
● $1 \times 10^{-5} > CCDP > 1 \times 10^{-6}$	Increasing trend - statistically significant



Trending Approach Used in SECY-05-0192

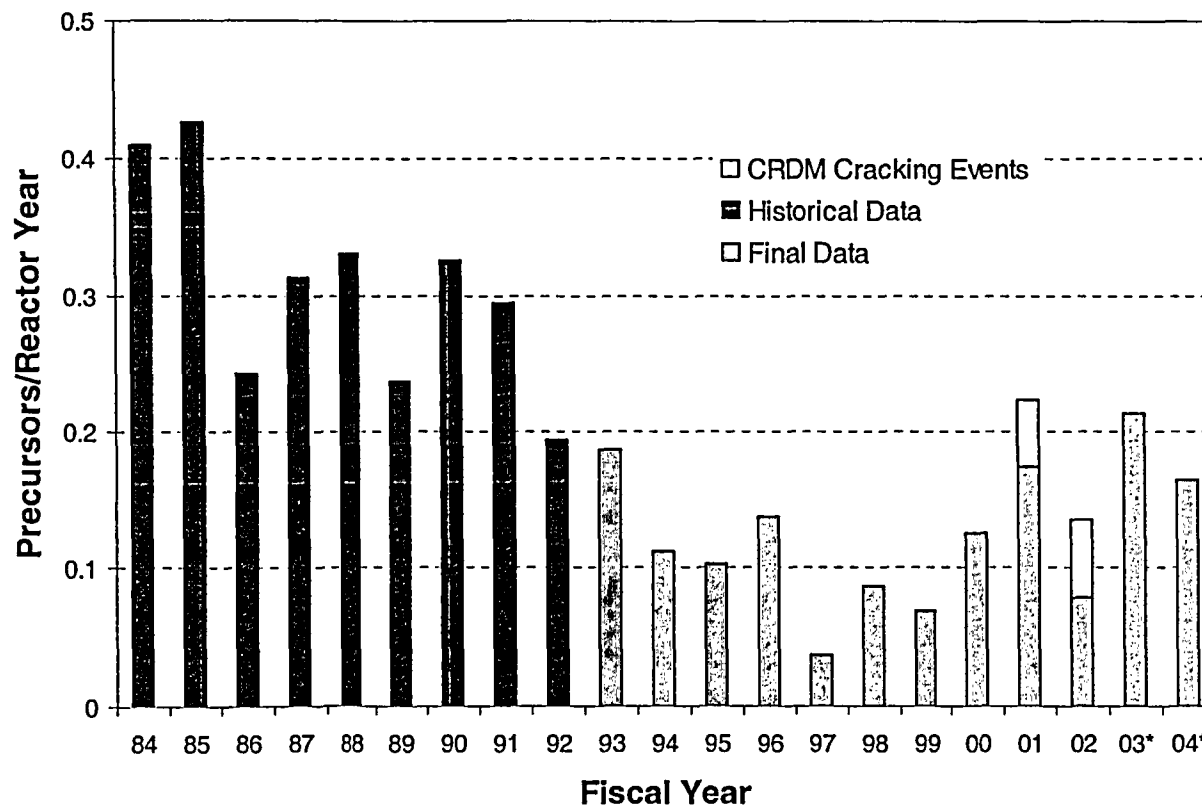
- **The SECY-05-0192 contains an expanded trending analysis. We will continue to refine and if necessary expand this section in future SECY papers.**
- **Uses the p-value approach for determining the probability of observing a trend as a result of chance alone**
- **A trend is considered statistically significant if the p-value is smaller than 0.05**
- **Trending starts at 1993 because of the advent of SPAR models.**



ASP RESULTS, TRENDS & INSIGHTS

A Historic Perspective

Number of Precursors by Fiscal Year

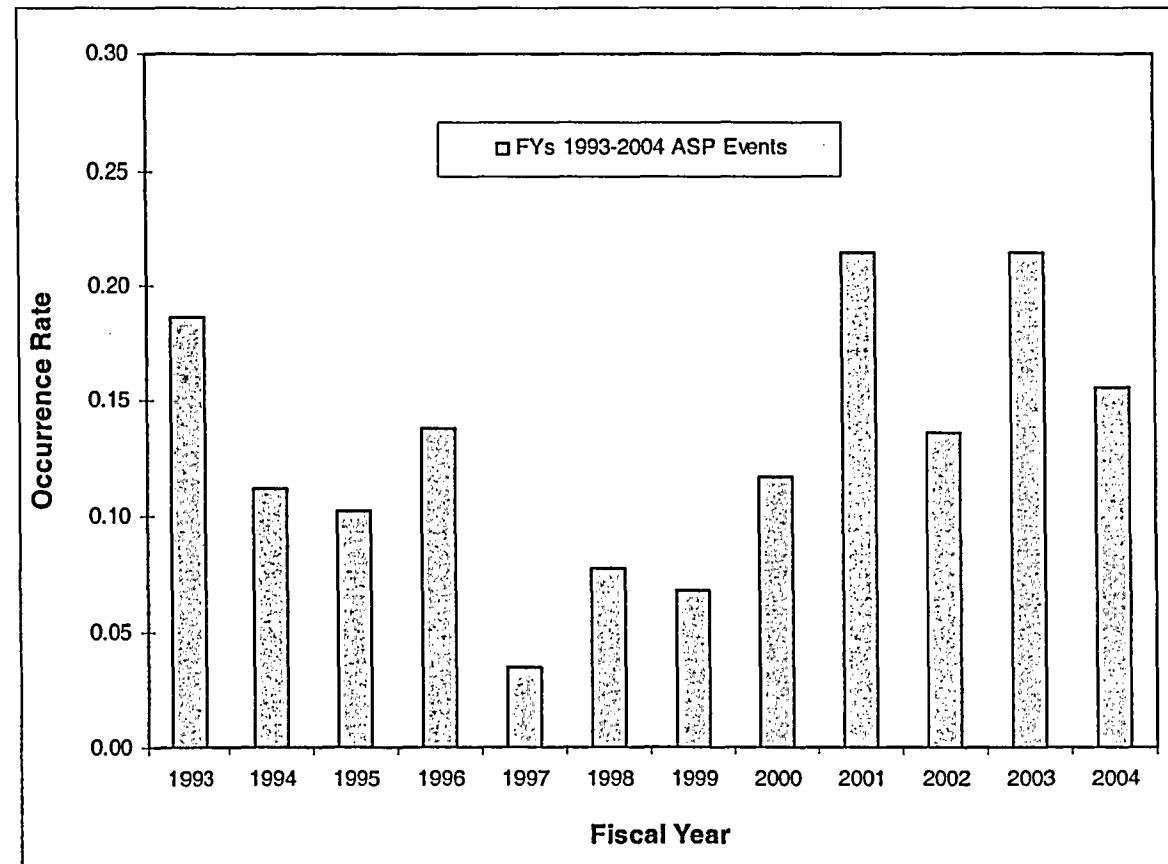


*Contains preliminary data



ASP RESULTS, TRENDS & INSIGHTS

No trend was identified in the rates of occurrence of all precursors during the period from FY 1993 through FY 2004 (p-value = 0.1016)



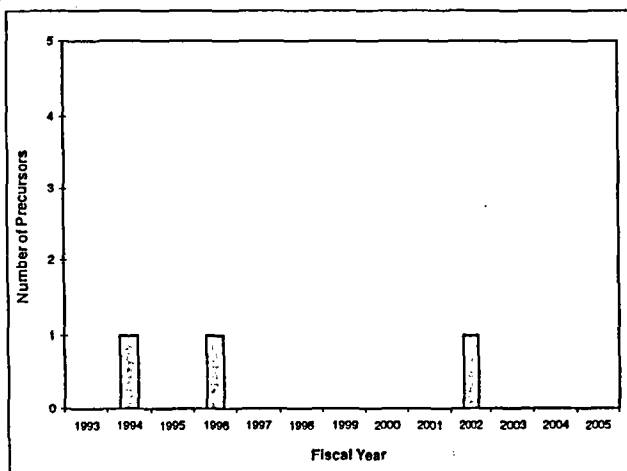
*Years after FY-2001 contain preliminary data

Source: SECY-05-192

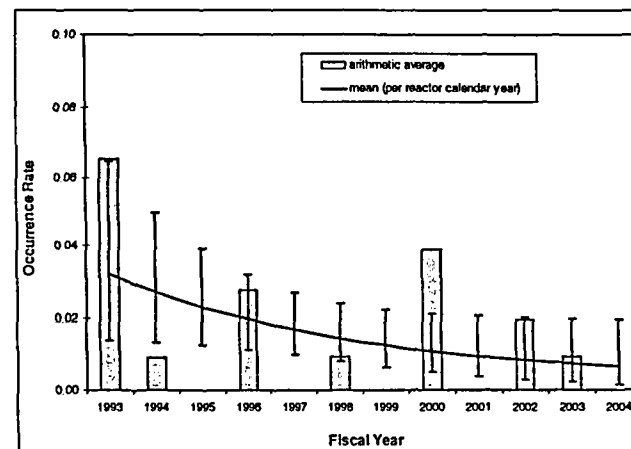


ASP Results, Trends & Insights

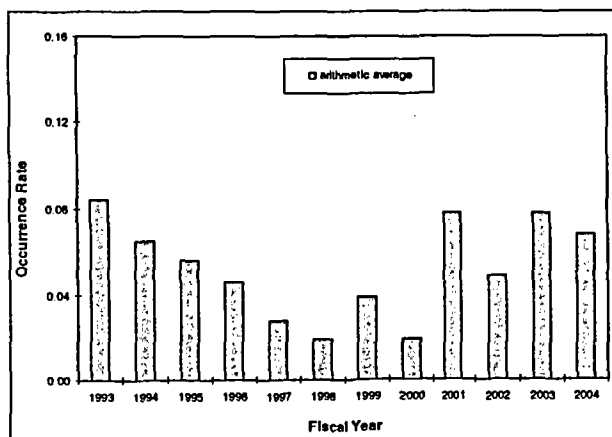
Trending of precursors by CCDP bins



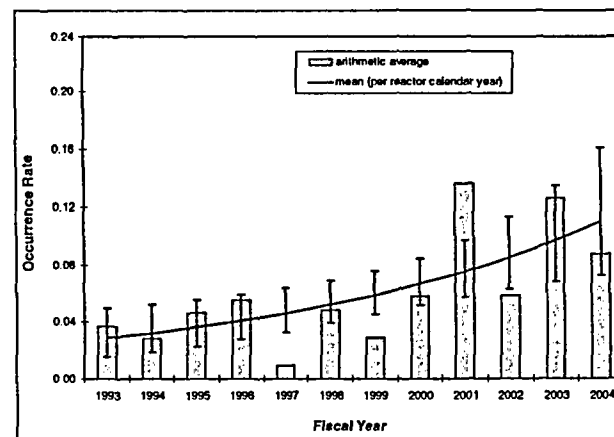
Precursors in CCDP bin 10^{-3}



Precursors in CCDP bin 10^{-4}



Precursors in CCDP bin 10^{-5}



Precursors in CCDP bin 10^{-6}

Source: SECY-05-192



Evaluations of Trends in Precursor Counts

- Trending was done for the FY 1997 – 2004 period and for the FY 2001 – 2004 period
- To ensure consistency of data, post-FY 2001 data was adjusted to reflect changes in event selection criteria. This 'rebaselining' accounts for:
 - Evolving analysis methods and SPAR models allow analysis of complex conditions (i.e., fire, external events, HELB and internal flooding) that were previously screened out.
 - ASP not analyzes all greater than green SDP findings
- Rebaselining removed 23 precursors from the data



Trending Evaluation Conclusions

- **Important Precursors ($> 1 \times 10^{-4}$) – No trend**
- **FY 1997 – 2004 trend**
 - Increase in scope of the ASP program is shown.
 - Increasing trend measured.
 - No trend remains if CRDM or LOOP events are removed.
- **FY 2001-2004 (re-baselining not needed) – No trend measured**



Additional Trending

■ Initiating Events vs Degraded Conditions

- Frequency of degraded conditions is increasing relative to initiating events
- This would be more pronounced if not for the increase in LOOP precursors

■ LOOP Initiating Events

- Statistically significant increasing trend FY 1993 – 2004
- Would not be statistically significant if not for August 14, 2003 event

■ Precursors at BWRs vs PWRs

- BWR precursors show an increasing trend
- PWR precursors do not show a trend



Two ASP Indices

■ Annual ASP Index

- **Assigns the risk of ASP events to the year in which it occurred**

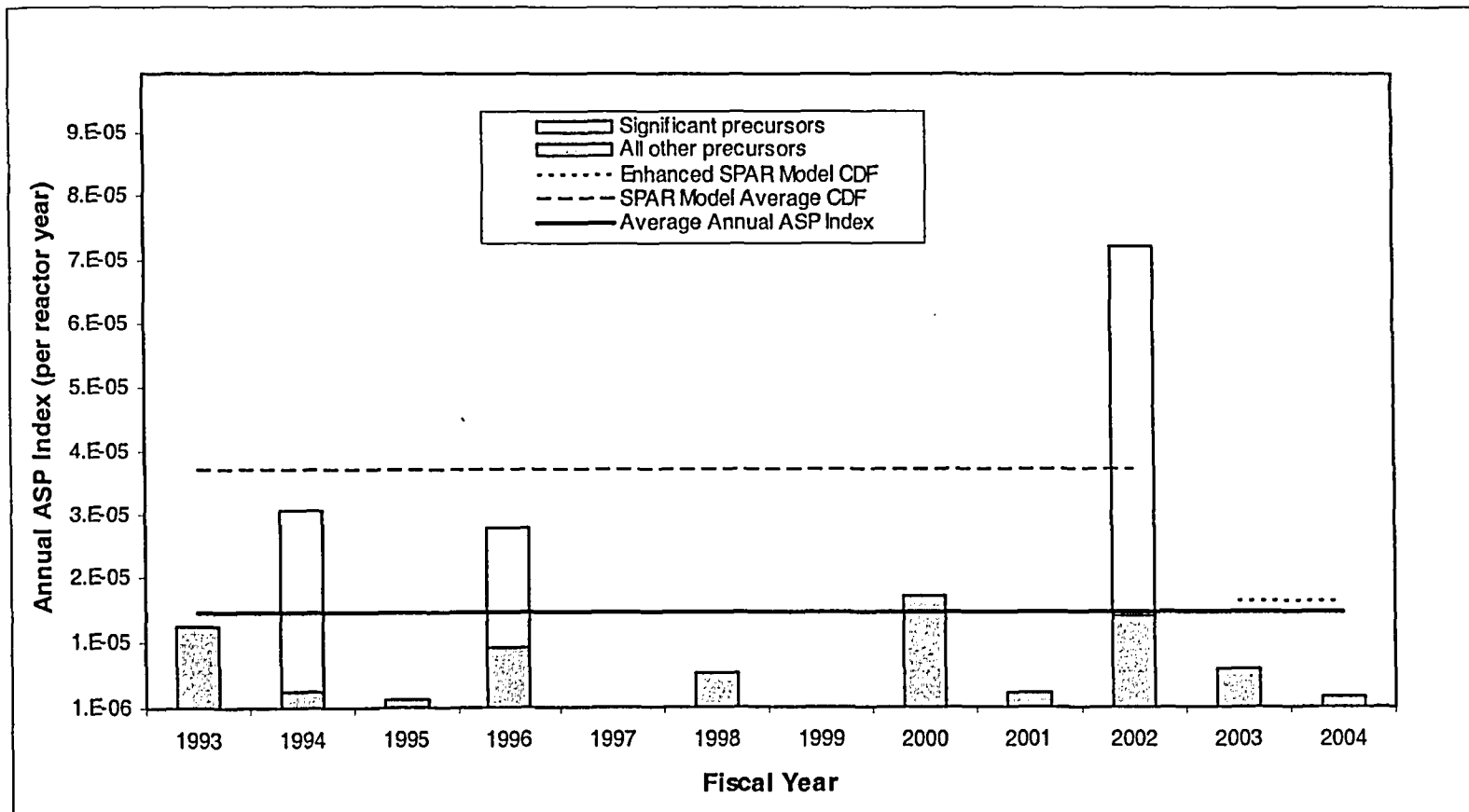
■ Integrated ASP Index (new)

- **Assigns the risk of ASP events to the actual duration**



Annual ASP Index

(Total CCDP and Δ CDP divided by the number of reactor years)





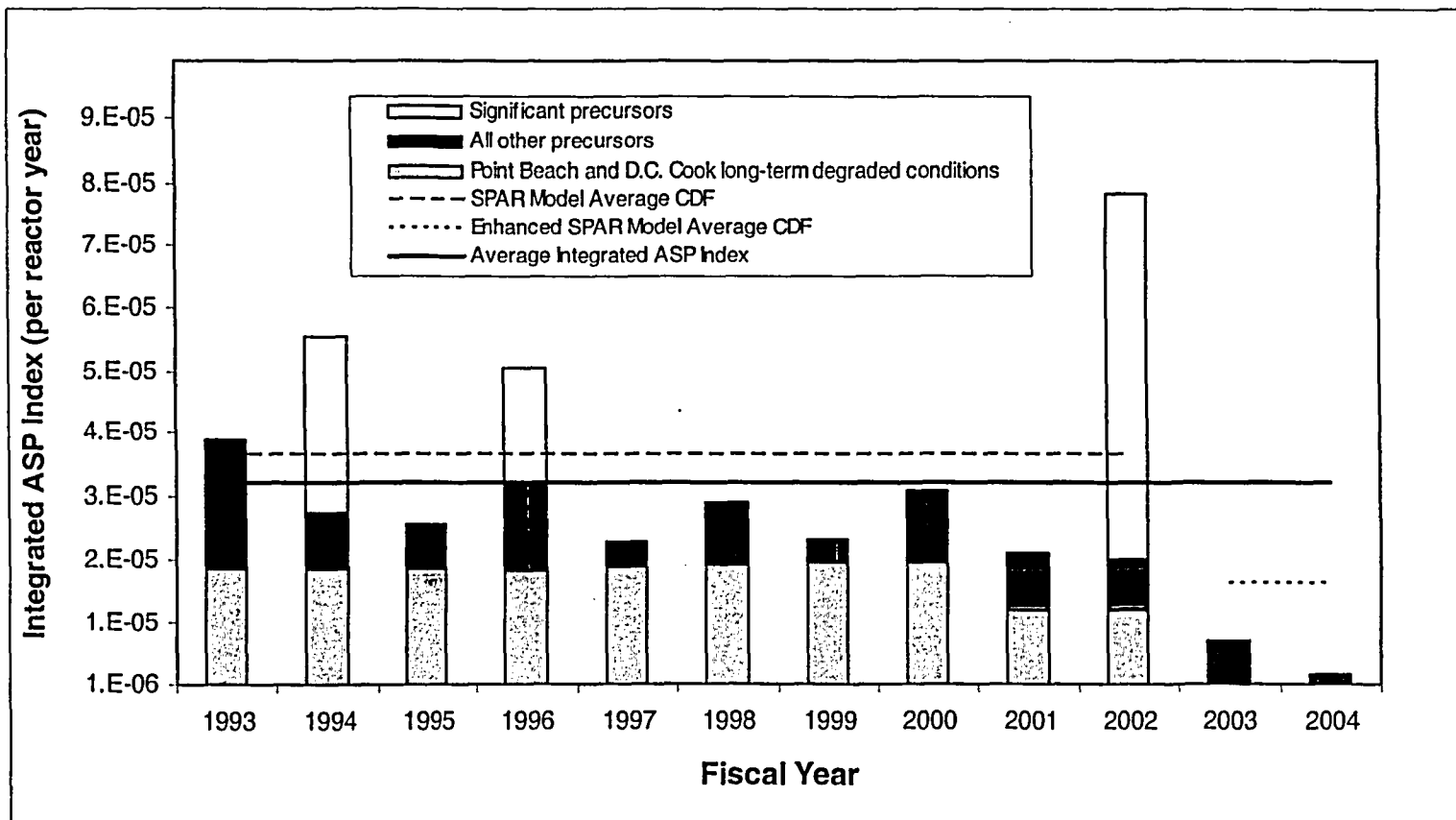
Results from the Annual ASP Index

- **Average ASP index is consistent with CDF estimates (same order of magnitude) from SPAR models (and therefore with licensee's models)**
- **Increases in the ASP index in FYs 1994, 1996 and 2002 are attributable to significant precursors**
- **Limitations to the Index**
 - **Use of CCDPs and Δ CDPs to estimate CDF is difficult due to imprecise mathematical relationships, sparse statistics and screened events**
 - **SPAR models only cover internal events**



Integrated ASP Index

(The total CCDP of all precursors divided by the number of Rx years)



Source: SECY-05-192



Description and Results of the Integrated ASP Index

(A New Index first published in SECY-05-0192)

- **Major feature – includes the risk of a precursor for the entire duration of the condition**
- **Initiating events are included in the year in which they occurred**
- **Results are consistent (same order of magnitude) with CDF estimates from SPAR and licensee models**
- **Insights on total contribution to integrated average CDF**
 - **Four precursors contribute nearly one-half**
 - **Three significant precursors contribute over one-quarter**
 - **The remaining quarter is from 156 precursors**



Summary

■ ASP Program Status

- The program continues to evaluate the safety significance of operational events
- FY 2004 analyses are essentially complete, and the preliminary results for FY 2005 events will be available to support the Agency Action Review Meeting (AARM) in April 2006

■ ASP Results

- The occurrence rate for higher risk precursors is constant or decreasing
- The overall risk from ASP events is relatively constant
- The number of precursors analyzed is affected by the SDP and recent increase in LOOP frequency



**BRIEFING OF THE ACRS:
EVALUATION OF ACCIDENT SEQUENCE
PRECURSOR DATA TO IDENTIFY SIGNIFICANT
OPERATING EVENTS**

March 10, 2006

Patrick W. Baranowsky, Deputy Director for Operating Experience & Risk Analysis
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 - LOOPs complicated by hurricanes and equipment failure
- S/D events with plants in vulnerable conditions
 - Solid Plant
 - Mid-loop

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ASP Results, Trends & Insights

Summarized from SECY-05-0192

- No significant precursors were identified in either FY 2003, FY 2004 or FY 2005. Davis-Besse was a significant precursor in FY 2002.
- Four precursors identified in FYs 2002-2004 had a CCDP greater than 1×10^{-4} . Includes Davis-Besse, the potential common mode failure of AFW at Point Beach 1 & 2, and another potential common mode failure of AFW at Point Beach 2.
- No trend was identified in the rates of occurrence of all precursors during the period from FY 1993 through FY 2004.
- Trending of precursors by CCDP bins yielded mixed results. If a trend is considered statistically significant, it is very unlikely that the trend is a result of chance alone. Trending analysis of precursors in the CCDP bins yielded the following results:

● $CCDP > 1 \times 10^{-3}$	No trend
● $1 \times 10^{-4} > CCDP > 1 \times 10^{-5}$	Decreasing trend - statistically significant
● $1 \times 10^{-5} > CCDP > 1 \times 10^{-6}$	No trend
● $1 \times 10^{-6} > CCDP > 1 \times 10^{-7}$	Increasing trend - statistically significant

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Trending Approach Used in SECY-05-0192

- The SECY-05-0192 contains an expanded trending analysis. We will continue to refine and if necessary expand this section in future SECY papers.
- Uses the p-value approach for determining the probability of observing a trend as a result of chance alone
- A trend is considered statistically significant if the p-value is smaller than 0.05
- Trending starts at 1993 because of the advent of SPAR models.

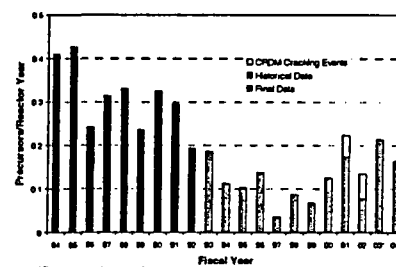
10



ASP RESULTS, TRENDS & INSIGHTS

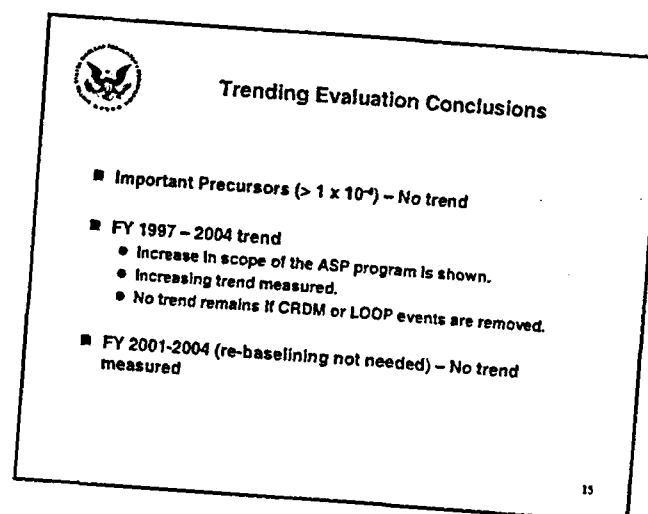
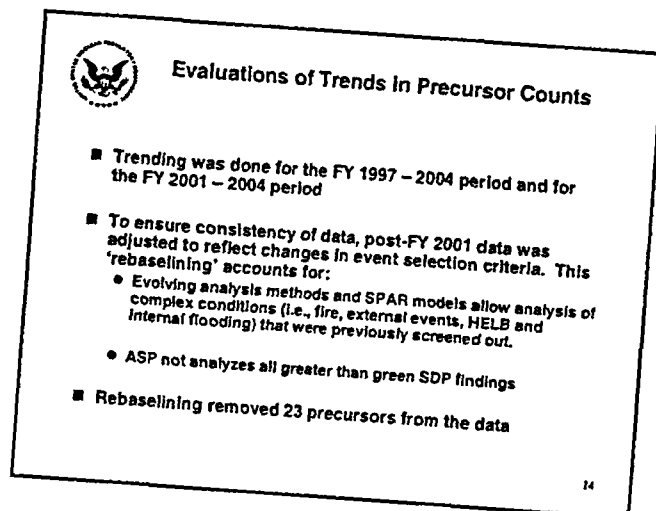
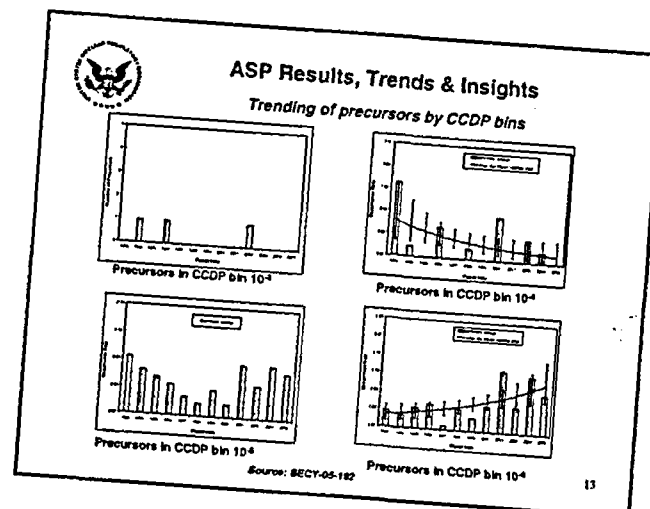
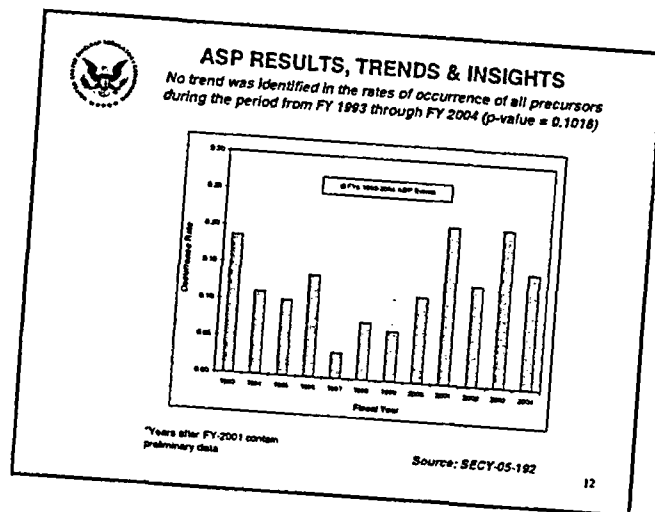
A Historic Perspective

Number of Precursors by Fiscal Year



*Contains preliminary data

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Additional Trending

- **Initiating Events vs Degraded Conditions**
 - Frequency of degraded conditions is increasing relative to initiating events
 - This would be more pronounced if not for the increase in LOOP precursors
- **LOOP Initiating Events**
 - Statistically significant increasing trend FY 1993 – 2004
 - Would not be statistically significant if not for August 14, 2003 event
- **Precursors at BWRs vs PWRs**
 - BWR precursors show an increasing trend
 - PWR precursors do not show a trend

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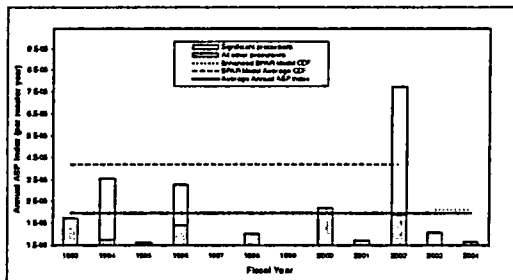
Two ASP Indices

- **Annual ASP Index**
 - Assigns the risk of ASP events to the year in which it occurred
- **Integrated ASP Index (new)**
 - Assigns the risk of ASP events to the actual duration

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Annual ASP Index (Total CCDP and ACDP divided by the number of reactor years)



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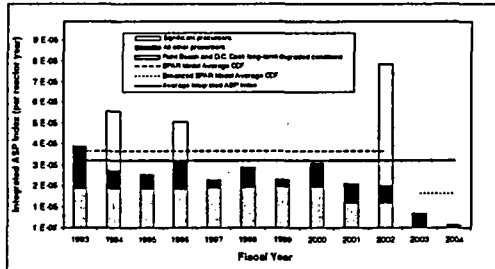
Results from the Annual ASP Index

- **Average ASP Index is consistent with CDF estimates (same order of magnitude) from SPAR models (and therefore with licensee's models)**
- **Increases in the ASP index in FYs 1994, 1996 and 2002 are attributable to significant precursors**
- **Limitations to the Index**
 - Use of CCDPs and ACDPs to estimate CDF is difficult due to imprecise mathematical relationships, sparse statistics and screened events
 - SPAR models only cover internal events

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Integrated ASP Index (The total CDF of all precursors divided by the number of Rx years)



Source: SECY-05-192

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Description and Results of the Integrated ASP Index (A New Index first published in SECY-05-0192)

- Major feature – includes the risk of a precursor for the entire duration of the condition
- Initiating events are included in the year in which they occurred
- Results are consistent (same order of magnitude) with CDF estimates from SPAR and licensee models
- Insights on total contribution to integrated average CDF
 - Four precursors contribute nearly one-half
 - Three significant precursors contribute over one-quarter
 - The remaining quarter is from 156 precursors

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Summary

- ASP Program Status
 - The program continues to evaluate the safety significance of operational events
 - FY 2004 analyses are essentially complete, and the preliminary results for FY 2005 events will be available to support the Agency Action Review Meeting (AARM) in April 2006
- ASP Results
 - The occurrence rate for higher risk precursors is constant or decreasing
 - The overall risk from ASP events is relatively constant
 - The number of precursors analyzed is affected by the SDP and recent increase in LOOP frequency

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