

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Title: **BRIEFING ON ACCIDENT SEQUENCE**
PRECURSOR PROGRAM - PUBLIC MEETING

Location: **Rockville, Maryland**

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1 UNITED STATES OF AMERICA
2 NUCLEAR REGULATORY COMMISSION

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4 BRIEFING ON ACCIDENT SEQUENCE PRECURSOR PROGRAM

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6 PUBLIC MEETING

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8
9 Nuclear Regulatory Commission

10 Room 1F-16

11 One White Flint Plaza

12 11555 Rockville Pike

13 Rockville, Maryland

14
15 Wednesday, November 15, 1995

16
17 The Commission met in open session, pursuant to
18 notice, at 10:00 a.m., the Honorable SHIRLEY A. JACKSON,
19 Chairman of the Commission, presiding.

20
21 COMMISSIONERS PRESENT:

22 SHIRLEY A. JACKSON, Chairman of the Commission

23 KENNETH C. ROGERS, Member of the Commission

24
25
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1 STAFF AND PRESENTERS SEATED AT THE COMMISSION TABLE:

2 KAREN D. CYR, OGC/NRC

3 ANDREW BATES, ACTING SECRETARY

4 JAMES TAYLOR, EDO

5 EDWARD JORDAN, DIRECTOR, AEOD

6 PATRICK BARANOWSKY, CHIEF, RELIABILITY AND RISK

7 ASSESSMENT BRANCH, AEOD

8 PATRICK O'REILLY, SENIOR REACTOR SYSTEMS ENGINEER,

9 AEOD

10 DAVID MORRISON, DIRECTOR, OFFICE OF NUCLEAR

11 REGULATORY RESEARCH

12 ASHOK THADANI, ASSOCIATE DIRECTOR FOR INSPECTION

13 AND TECHNICAL ASSESSMENT, OFFICE OF NUCLEAR

14 REGULATORY RESEARCH

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P R O C E E D I N G S

[10:00 a.m.]

COMMISSIONER JACKSON: Good morning.

The purpose of this meeting is for the staff to brief the Commission on the Accident Sequence Precursor Program. The Commission was last briefed on the Accident Sequence Precursor Program in 1993.

I understand that this briefing will include the background of the ASP Program, the results of the 1994 Event Analysis, and an overview of the current status of the program. I also understand that copies of the presentation are available at the entrance to the meeting.

Commissioner Rogers, do you have any opening comments?

COMMISSIONER ROGERS: Not at the beginning, thank you.

COMMISSIONER JACKSON: Mr. Taylor, you may proceed.

MR. TAYLOR: Good morning. This Accident Sequence Precursor Program was an early application of probabilistic risk methodology, and it certainly has benefited NRC understanding of the event risk significance since we started in the early 1980s. We, as you will hear today, the methodology is continuing to be improved. As we utilize it, we believe that these improvements will help with the

1 results, and you will hear about that today.

2 AEOD relies upon the program and its independent
3 review of operating experience to help assess the safety
4 significance of events or conditions at nuclear power
5 plants, and AEOD has the responsibility for program
6 oversight.

7 NRR utilizes the ASP methodology for screening of
8 events and conditions and research is responsible for the
9 development of the methodology.

10 Each of those offices are here represented by Mr.
11 Thadani, Mr. Jordan, Mr. Morrison, and Pat O'Reilly and Pat
12 Baranowsky from the AEOD staff are part of the presentation
13 today.

14 Mr. Jordan will continue.

15 MR. JORDAN: Thank you.

16 We did last brief the Commission directly on the
17 Accident Sequence Precursor Program in 1993, although we
18 have had recently three briefings that had some comments
19 about the Accident Sequence Precursor Program, the 1995 PRA
20 Implementation Plan briefing identified as an element of the
21 ongoing PRA-based program to assist in evaluation of event
22 risk significance. The April 1995 proposed rule on
23 reliability and availability data identified ASP as one of
24 the PRA activities which would benefit from equipment
25 performance data. In the August 22 briefing on changes to

1 performance indicators, during that briefing we discussed
2 the contribution sequence coding and search system makes to
3 screening of events for subsequent ASP evaluation, and we
4 discussed the role that ASP type analysis is projected to
5 have in augmenting the significant events performance
6 indicator with a risk perspective.

7 The first slide is up and, Madam Chairman, you
8 have already identified the agenda we are going to be
9 covering. I would like to recognize the excellent technical
10 cooperation between the three offices in ASP and through the
11 technical coordination group. That is a very effective
12 mechanism to attain that level of cooperation.

13 I will now turn it over to Dr. Pat O'Reilly who
14 will make the presentation and Pat Baranowsky and I will
15 respond to questions.

16 Thank you.

17 MR. O'REILLY: Thank you, Ed.

18 May I have the next visual, please.

19 There are several objectives of the Accident
20 Sequence Precursor Program. Two of them are original
21 objectives, and the remainder have evolved over the years as
22 our knowledge and our expertise in applying the ASP
23 methodology has increased.

24 First of all, it identifies and ranks the risk
25 significance of operational events. It also determines the

1 generic implications of an operational event and
2 characterizes risk insights. It provides supplemental
3 information on plant specific performance. It provides a
4 check with PRAs. In this sense, it is right now a goal.
5 The staff, informally, on a case-by-case basis is doing
6 this.

7 It also provides an empirical indication of
8 industry risk and associated trends.

9 COMMISSIONER ROGERS: Just before you leave that,
10 how is that information being provided? What is the
11 mechanism? I noticed in the SECY 95-269 a table year-by-
12 year of the different levels of events that might have
13 occurred, and that is kind of a dramatic indication of a
14 real diminution of these events.

15 Has that, or something like that, been
16 communicated to the industry and to the public? Do you know
17 what I am talking about by this table?

18 MR. JORDAN: Yes, I do. We have read those
19 findings, and we have used it in a number of briefings,
20 regulatory information conferences to indicate that there is
21 clearly a decline. Pat is going to discuss some, I will
22 say, somewhat subjective information in terms of numbers and
23 types of events compared over a ten-year period that will
24 make that clearer. We are very interested in developing, I
25 would say, a rigorous methodology that would let us convey

1 more clearly the change in risk, and we are not there yet.
2 We, I think, mentioned it during the performance indicator
3 discussion. I hope we are about two years away.

4 COMMISSIONER JACKSON: We will come back to that
5 question.

6 MR. JORDAN: I am sure.

7 MR. THADANI: In fact, every time we have a
8 regulatory information conference, this is presented during
9 the plenary session when everyone is present, just to
10 indicate trends. I think, as Ed said, there are other
11 issues, of course.

12 COMMISSIONER ROGERS: Well, that's fine, but I do
13 think some kind of a publication of it is also worth doing.
14 If that is the only communication we have, it hits those
15 people that are there, and so on and so forth, but it would
16 be nice to have some kind of a document that contains that
17 that is a public document.

18 MR. JORDAN: Right. Our annual AEOD report does
19 compile those, and we would continue to do that. We have
20 made comments in our annual report to Congress that we
21 submit, performance indicators.

22 COMMISSIONER JACKSON: Is that also available in
23 the public document room?

24 MR. JORDAN: Yes.

25 COMMISSIONER ROGERS: Thank you.

1 MR. O'REILLY: May I have the next visual, please.

2 There are several definitions in the ASP Program
3 which are important. First of all, accident sequences of
4 interest. Those are sequences which, if they had occurred,
5 would have led to inadequate core cooling and potential core
6 damage.

7 An accident sequence precursor is an event or a
8 condition which is an important element in those sequences,
9 such as an unusual initiating event or failures or multiple
10 components which, when coupled with one or more postulated
11 events, can result in severe core damage.

12 There is a term which is not on this slide which
13 is important for some of the discussion we will have a
14 little bit later, and that is conditional core damage
15 probability. That is the conditional probability of core
16 damage given that a failure or failures did occur.

17 The threshold in the ASP Program for conditional
18 core damage probability is 1.0 times 10 to the minus 6. Any
19 event that has a CCDP that is greater than that value is
20 termed a precursor in the ASP Program.

21 There are also a number of events which we
22 categorize as containment related event. Currently the ASP
23 Program does not have the capability to analyze those types
24 of events, but they are identified in the annual precursor
25 report. Those are any events that include failures that

1 could degrade or fail containment performance.

2 COMMISSIONER ROGERS: Do you draw any distinction
3 between core damage and severe core damage in the use of
4 those terms?

5 MR. O'REILLY: No.

6 COMMISSIONER ROGERS: No. So they are
7 interchangeable?

8 MR. O'REILLY: Correct.

9 COMMISSIONER ROGERS: Core damage and severe core
10 damage are essentially interchangeable?

11 MR. O'REILLY: That's right.

12 COMMISSIONER JACKSON: Let me ask you a question
13 now, when you talk about the 10 to the minus 6 probability,
14 are you looking at a particular sequence and you are looking
15 at a particular branch probability and if that probability
16 is, in fact, greater than 10 to the minus 6, then you
17 include it as a precursor?

18 MR. O'REILLY: Well, you have asked me to get
19 ahead of my presentation, but I can tell you that we will
20 walk you through an example of the ASP methodology in just a
21 few minutes, and I think it will make it clearer than if I
22 just tried to respond to you without a visual.

23 COMMISSIONER JACKSON: Fine.

24 MR. BARANOWSKY: It is mostly yes, though.

25 COMMISSIONER JACKSON: Mostly yes.

1 MR. BARANOWSKY: I mean, the sequence probability
2 is what we are talking about.

3 COMMISSIONER JACKSON: All right.

4 MR. O'REILLY: May I have the next visual, please.

5 A brief historical background of the ASP Program.
6 The program was started in 1979 in response to the peer
7 review of WASH-1400, the reactor safety study that was
8 conducted by the Lewis Committee. Initially, Research had
9 the responsibility for the ASP Program. They developed and
10 issued the first two precursor reports.

11 The first report generated a great deal of concern
12 among the industry when it was issued in 1982. The program
13 matured as the techniques and the methodology was refined to
14 respond to the comments received on the first report, and
15 gradually the program matured and the responsibility for the
16 program was transferred to AEOD in 1985.

17 MR. JORDAN: I would make a comment that it is
18 kind of interesting to look back, and when the ASP Program
19 was initiated it was a very controversial program. There
20 were great concerns of the misuse of this kind of data with
21 very simple event trees and limited numbers of models. The
22 industry and the scientific community at large were
23 concerned about it in terms of potential adverse effect.

24 MR. O'REILLY: Since its inception, the ASP
25 Program has processed more than 50,000 LERs and has

1 identified and documented about 585 precursors in the
2 precursor reports.

3 May I have the next slide, please?

4 This slide shows the first cut of the ASP Program.
5 The first two reports which covered the periods 1969 through
6 1979, 1980 and 1981 represent a look back into time after
7 the Three Mile Island accident. In these reports, the ASP
8 Program identified the more important events of these two
9 periods as significant precursors. In that respect, I am
10 talking about precursors that had a conditional core damage
11 probability greater than 10^{-3} .

12 This slide shows five of those precursors. There
13 were 19 others. This is a large number of significant
14 precursors. They represented more or less a flag that the
15 industry and the regulator alike had to do something or we
16 were headed for trouble. Although these events had already
17 received some regulatory action, the ASP Program provided a
18 risk perspective of these events that had previously been
19 missing.

20 Compared to the types of precursors that we have
21 seen recently, these events were quite significant. Each of
22 the events listed on that slide conveys an important lesson
23 to the regulator and to the industry alike. For example,
24 the 1974 Turkey Point 3 event pointed out the importance of
25 the auxiliary feedwater system.

1 The 1975 Browns Ferry precursor showed the
2 importance of cable separation for trains of redundant
3 systems, and it also led to the promulgation of Appendix R
4 to 10 CFR Part 50.

5 The 1977 Davis-Besse precursor was a precursor to
6 the TMI 2 accident. The 1978 Rancho Seco precursor was the
7 famous lightbulb incident. It highlighted the safety
8 significance of the coupling between the secondary side
9 systems and the primary systems.

10 The 1980 Crystal River 3 precursor also involved
11 problems with the non-nuclear instrumentation system, but in
12 addition it resulted in discharge of about 42,000 of
13 coolants into the containment because the high pressure
14 injection was left on for a long period of time. This
15 pointed out the need that led to establishing a set of ECCS
16 termination criteria for recovery from transients.

17 May I have the next visual, please?

18 From 1984 on, the ASP Program has monitored the
19 operating experience of U.S. plants, and has identified the
20 most important events from a risk significant standpoint on
21 a yearly basis. The ASP Program was instrumental in
22 clarifying for the staff the relatively high risk
23 significance of two of these precursors, the Shearon Harris
24 long-term HPI unavailability and the Wolf Creek shutdown
25 event which occurred last year. I will say more about the

1 Wolf Creek event a little bit later.

2 Note that the conditional core damage probability
3 for these most significant precursors exhibited a drop
4 during the period 1986 through 1994. In other words, the
5 higher numbers were no longer as high as a lot of the
6 precursors that we had seen in the pre-1984 time period.

7 One other note, that is, the number of significant
8 precursors also decreased, whereas there were 26 between
9 1969 and 1981, since 1984 there have been seven.

10 May I have the next visual, please?

11 I will now give you a brief overview of the ASP
12 screening review and analysis process. First of all, the
13 screening step. LERs represent the largest source of
14 operational experience data for the ASP Program. They are
15 not the only source. The sequence coding and search system,
16 LER database, is screened by a computerized algorithm to
17 identify LERs or events that are candidate precursors using
18 search criteria which look for failures in a plant that
19 provide protective functions for the plant against certain
20 core damage related events.

21 Since this algorithm was put in use in the program
22 in 1991, it has proven to be a very useful tool. Prior to
23 its development, it was necessary to manually screen every
24 LER that was received. Out of a total number of LERs that
25 are submitted to the NRC each year, about one-fourth of the

1 LERs are screened out by this algorithm.

2 As I said, LERs are not the only source of
3 candidate precursors. Any the event that is reviewed by
4 either an incident investigation team or an augmented
5 inspection team is automatically put into the ASP review
6 process. Also, any event that the NRC staff designates as a
7 significant event is put into the ASP review process. The
8 results of NRC's daily screening of operational events also
9 gets fed into the ASP process. NRR also performs selected
10 prompt assessments of operating events and the results of
11 those assessments are fed into the process.

12 Finally, any event identified by the NRC staff,
13 regardless of its documentation, it could be a 10 CFR 50.72
14 phone call, could be in an inspection report, that gets fed
15 into the review process as well.

16 COMMISSIONER ROGERS: Looking at that list, is it
17 possible to analyze it for those sources which seem to be
18 most important and most useful, or can't you say anything
19 about that? In other words, can you prioritize these
20 sources of candidate precursors in some way?

21 MR. O'REILLY: Yes. Definitely, most of them come
22 from LERs, less than 5 percent actually have no other
23 documentation -- I'm sorry, do not have an LER associated
24 with them eventually.

25 COMMISSIONER ROGERS: And those would be fed into

1 the SCSS program?

2 MR. O'REILLY: They are fed into the ASP Program
3 directly. The LER information comes from the SCSS Program,
4 yes.

5 COMMISSIONER ROGERS: I see, backwards. Okay.

6 MR. BARANOWSKY: Some 50.72s may be an early
7 heads-up to an event which eventually has an LER. So I
8 think when we say LERs are the primary source, there may be
9 50.72s that got us started early on it also.

10 MR. O'REILLY: Right. We prefer LER information
11 because a 50.72 report, since it is very preliminary,
12 certain details may have changed, circumstances may have
13 been somewhat different.

14 COMMISSIONER JACKSON: And they don't have the
15 full root causes analysis.

16 MR. O'REILLY: That's correct.

17 The next step in the process is an engineering
18 review of every selected event. Right now, every LER or
19 event is reviewed independently by two engineers against
20 predefined criteria. The purpose of that is to determine
21 whether this event has potential risk significance and is
22 worthy of greater detailed analysis.

23 COMMISSIONER JACKSON: Now these engineers, are
24 these our engineers or are these the ones at Sandia?

25 MR. O'REILLY: There are contractors. Right now

1 Oak Ridge National Laboratory is the prime contractor for
2 most of the ASP Program work. The yearly screening is done
3 at Oak Ridge. Sandia National Labs is performing the
4 analysis of events which occurred in 1982 and 1983 to fill
5 in the gap that exists right now in the ASP database.

6 Each event that is recommended for detailed
7 analysis is then analyzed and quantified. Quantification
8 consists of calculating the conditional core damage
9 probability, and any event whose CCDP is greater than 10 to
10 the minus 6 is documented and the results of the preliminary
11 analysis are then sent out to the affected licensee, to the
12 NRC staff, and to an independent NRC contractor for peer
13 review.

14 Each comment that we receive from that review is
15 evaluated and, if necessary, the event is reanalyzed. The
16 final analysis is then reviewed by our independent
17 contractor and then the final analyses are put together in
18 the annual report, and the report is issued.

19 MR. JORDAN: We may be understating the reviews
20 that the staff do and the analysis that the staff does. NRR
21 in real time uses the ASP methodology to evaluate events on
22 a very timely basis. My staff also do preliminary ASP
23 analysis to identify an issue. The Wolf Creek event that we
24 will talk a little more about was one of those, that early
25 screening was very helpful in identifying, this is truly a

1 risk significant event that is not being given the right
2 attention. It is very useful tool for the staff.

3 COMMISSIONER JACKSON: So what really is
4 distinguishing what you are doing in some sense from a full
5 blown PRA has to do with the frequency of the initiator; is
6 that right? I mean, you don't have that in your analysis?

7 MR. JORDAN: We do use --

8 COMMISSIONER JACKSON: You are calculating a
9 conditional core damage probability

10 MR. JORDAN: Right, given the event that happened.

11 COMMISSIONER JACKSON: Not a core damage
12 frequency?

13 MR. JORDAN: That's correct.

14 MR. THADANI: What you said is correct.

15 By the way, I also want to expand on what Ed said.
16 When 50.72, .73, reports come in and so on, there is
17 actually a group of people, it is sort of a multi-
18 disciplinary group of people, and AEOD also participates in
19 that process. They first take a look and decide if the
20 event is significant or not. One person in that group is
21 someone who has PRA background, knows how to do ASP analyses
22 and so on. So the initial cut is done in-house on a number
23 of these events, and if the decision is made that we ought
24 to do a quick ASP type analysis, then that is also done in-
25 house.

1 The results of those analyses are actually fed
2 into AEOD follow-on activities, so that we don't recreate
3 what has already been done, unless things have changed. So
4 that information is, in fact, looked at again by AEOD
5 subsequently. So the initial cut on these events as they
6 come in is done in-house.

7 COMMISSIONER JACKSON: Okay.

8 MR. O'REILLY: That is what I referred to as NRR's
9 prompt assessments.

10 COMMISSIONER JACKSON: I see.

11 MR. O'REILLY: The last four steps in the process
12 are currently being evaluated to determine how they could be
13 streamlined to make the overall process more efficient and
14 maintain, at the same time, high technical quality.

15 May I have the next visual, please?

16 This is a pictorial example of entry which was
17 used in the precursor analysis of the Shearon Harris HPI
18 unavailability. What it does, it allows you to map the
19 various sequences that could occur onto a format that allows
20 it to be quantified. The headings at the top represent the
21 functions that must operate or must be successful in order
22 to prevent core damage. They are the initiating event,
23 which is a loss of coolant accident, reactor trip, auxiliary
24 feedwater, main feedwater, high-pressure injection, high-
25 pressure recirculation, and opening of the pressurizer PORV.

1 In the Shearon Harris case, the event was analyzed
2 as an unavailability of both trains of emergency core
3 cooling in the high-pressure injection mode for a period of
4 one year. And the frequency of the LOCA was converted into
5 a probability of the LOCA occurring during that period, and
6 that turned out to be about 6.3 times 10 to the minus 3.

7 Now, the reactor trip function is a very highly
8 reliable function. Going up on an event tree denotes
9 success, so in the particular case of the Shearon Harris
10 event, the HPI function was found failed. We assumed it was
11 failed, so we input a probability of 1 for the failure of
12 HPI. The probabilities of success of aux feed and the
13 reactor trip function are almost 1 because they are the
14 complement of a very small number. So when you multiply out
15 the various probabilities at the branch points in that event
16 tree, you get 6.3 times 10 to the minus 3.

17 The other sequences do not contribute very much
18 because their CCDP is so small. You then add them up, and
19 the total in this particular case is the same as that
20 dominant sequence, 6.3 times 10 to the minus 3. That is how
21 a condition or an unavailability is handled.

22 The calculation for an actual event that occurs is
23 very similar, except you assume the event has occurred, so
24 the probability of its occurrence is 1. That is the biggest
25 difference.

1 MR. THADANI: Let me make a comment on that
2 because it sort of comes back to what Commissioner Rogers
3 indicated earlier, core damage and severe core damage.
4 Basically when you get a point where you say you have
5 inadequate core cooling, you then go on and assume that that
6 is really going to lead to substantial damage.

7 In this case, it may have been, in fact, that the
8 HPI could have delivered some flow to the core, and that
9 that would require fairly extensive thermal hydraulic
10 analysis to see what kinds of small breaks you might, in
11 fact, be okay for. Whereas, there are others that you
12 wouldn't be able to deal with. So there is a certain amount
13 of conservatism in these analyses that way.

14 MR. BARANOWSKY: That's true, although we are
15 trying to eliminate as much conservatism as we can.

16 I might also point out what looks pretty simple
17 here, 1.0 for up and down on the different events. The
18 engineers on this had to take some time to take a look at
19 the description of the event to understand how the system
20 would fail and whether it would satisfy the accident
21 sequence function that we were talking about over here. The
22 event tree depiction is fairly simple, but what goes into
23 deriving the conditional failure probability sometimes is
24 not, especially if human performance issues, including
25 recovery, get tossed into the pot. So sometimes these

1 things can take a fairly extensive amount of evaluation of
2 each event, each branch on the tree. So we picked an easy
3 one for you this time.

4 MR. JORDAN: But I think it is important to make
5 the point that the event report was a rather benign report.
6 The review by the region and by the staff of the event in
7 real time did not indicate this was a significant precursor
8 at all. And so it was the more methodological subsequent
9 review that raised the flag and said, this is one that our
10 normal process missed. So this illustrates the value of
11 doing this in a rigorous fashion because we really simply
12 missed it from a deterministic level of review. It wasn't
13 one that rose high in significance.

14 COMMISSIONER JACKSON: Well, you know what is
15 interesting, though, is there are two significant aspects to
16 it. One is that essentially because the high-pressure
17 injection system was unavailable, that is, in a way, a huge
18 dominating factor in this particular sequence, coupled with
19 the probability of a LOCA to start with, basically.

20 MR. JORDAN: Right. It seems blatantly clear, but
21 the report and the initial review indicated a problem with
22 the miniflow line. It didn't indicate that the HPSI system
23 was unavailable during that time. So it was pulling the
24 string and then going from, how does the miniflow problem
25 affect the operability of the system that the real

1 significance came out.

2 COMMISSIONER JACKSON: I see.

3 MR. JORDAN: This was the point I was going to try
4 to make. It concentrated strictly on the miniflow line
5 condition.

6 COMMISSIONER JACKSON: The question is, what is
7 root cause?

8 MR. JORDAN: Right.

9 COMMISSIONER ROGERS: It reminds one of the story,
10 you know, how did things go? Everything was all right
11 except the dog died. When you go back to why the dog died,
12 the house burned down.

13 MR. O'REILLY: May I have the next visual, please?

14 Now we move into the results of the precursor
15 analyses of 1994 operational events. These are presented
16 according to power level. We have divided them up into
17 those precursors which occurred or could have occurred
18 during power operations, and those precursors which occurred
19 and only could have occurred because the plant was shutdown.

20 We have further subdivided those categories into
21 precursors that involved conditions or unavailabilities of
22 safety equipment, and precursors that involve actual
23 initiating events.

24 The precursor in the at-power unavailabilities
25 group with the highest CCDP is the Haddam Neck condition.

1 It involved degraded pressurizer PORVs and it degraded 480
2 volt vital bus.

3 This is the second year that the vulnerability of
4 the plant's electrical distribution system has led to a
5 precursor. Since the 1994 precursor occurred, the Haddam
6 Neck licensee has taken measures to fix the problem
7 permanently. The plant's PRA had also identified the same
8 vulnerability as the dominant contributor to plant risk, and
9 the ASP Program results have confirmed that.

10 May I have the next visual, please?

11 The next slide shows the continuation of the at-
12 power precursors with unavailabilities.

13 May I have the next visual, please?

14 This visual shows the results from the 1994 ASP
15 analyses for at-power precursors that involved an initiator
16 and it shows the one precursor which occurred during
17 shutdown. I will say more about the Wolf Creek event a
18 little bit later.

19 COMMISSIONER JACKSON: It has the highest
20 probability, I note.

21 MR. O'REILLY: Not just that, I can go into it
22 now.

23 May I have the next visual, please?

24 Some of the insights that were gleaned from the
25 1994 ASP results, as you pointed out, Madam Chairman, the

1 Wolf Creek shutdown event did have the highest conditional
2 core damage probability for 1994, and that is the highest
3 CCDP that we have seen in the program since 1991 and the
4 Shearon Harris condition.

5 MR. JORDAN: It probably also has the greatest
6 uncertainty.

7 MR. O'REILLY: That's correct. There are a lot of
8 parameters that affected the outcome of this analysis, one
9 of which was the human performance analysis, a lot of
10 uncertainty in that. There is also lots of uncertainty
11 about the viability of the so-called "reflex cooling method"
12 for getting water back into the core region from a boiling
13 core, being the condensation from the steam generators, and
14 there is also uncertainty about the behavior of the reactor
15 coolant system under those conditions. We did not have a
16 very good handle on that. So, consequently, the estimate of
17 CCDP in the case of the Wolf Creek event has a large
18 uncertainty associated with it.

19 COMMISSIONER JACKSON: Okay. I am going to come
20 back to ask you a question about that.

21 MR. THADANI: I would like to comment on that. We
22 also found this event was significant. There are two
23 things, as you know, drain down events during shutdown are
24 of concern and, in general, they are being addressed as part
25 of our shutdown rulemaking activity. But this event seems

1 to us to be significant enough that we are looking at
2 showing generic communication to make sure that the -- an
3 information notice was issued, of course, but I think we
4 want to make another step, issue a generic communication,
5 and then we would followup with some temporary instruction
6 to make sure that attention is, in fact, being paid to
7 events like this. We didn't think it was appropriate to
8 wait until shutdown rulemaking activities get finalized.

9 MR. O'REILLY: Most of the precursors for 1994
10 involved problems with electrical equipment. In fact, seven
11 out of nine had that trait. This is consistent with the ASP
12 results over the last five years when we find that about 60
13 percent of the precursors on the average involve electrical
14 equipment problems of one type or another.

15 We also observed that the number of precursors
16 that involved initiators has continued to decrease. In
17 1992, there were 12 of these. That went down to eight in
18 1993, and now we have two for 1994.

19 COMMISSIONER ROGERS: Any thoughts on why?

20 MR. JORDAN: Well, the overall trip rate is down
21 for plants, and so it is in that same sort of line in terms
22 of the initiators. The feedwater transients are those
23 things that initiate a sequence of events, their frequency
24 is down.

25 COMMISSIONER ROGERS: Do you think it is just a

1 collection of improvements that has given rise to this?

2 MR. JORDAN: Yes.

3 MR. TAYLOR: I think it is a collection.

4 MR. JORDAN: Operational reliability reduces
5 those.

6 COMMISSIONER JACKSON: Right, the trips.

7 MR. O'REILLY: Next, I would like to give a very
8 brief overview of the Commission paper that we submitted on
9 the status of the ASP Program which is designated SECY 95-
10 269.

11 One important aspect of the program which we feel
12 has really helped the success of the program has been the
13 interoffice technical coordination group. Ed referred to it
14 in his opening remarks, and I can't emphasize the role that
15 this group plays enough. It meets monthly. We discuss the
16 results of analysis of operational events. We get feedback
17 from NRR. We keep our finger on NRR's pulse. We know what
18 they are dealing with in terms of important events. It also
19 gives an interoffice coordination for guiding research
20 programs.

21 One of the things that the interoffice technical
22 coordination group did was recommend that various model and
23 methods development efforts be coordinated in research.
24 That was done and we coordinated the transfer of some
25 projects from other offices to research.

1 The 1994 precursor report is scheduled for
2 publication in late November. The screening review and
3 analysis of 1995 events began in May of this year, and that
4 is the earliest that such a process has been initiated
5 during the year.

6 The review and analysis of 1982 and 1983 LERs to
7 fill in the missing ASP data is winding down at Sandia
8 National Laboratories. A draft report is scheduled for
9 submittal in late November. This effort used current
10 models. It used current search and review techniques. As a
11 result, the preliminary results indicate that there will be
12 a larger number of precursors than we found in either 1981
13 or in 1984.

14 COMMISSIONER ROGERS: Can you just say a bit about
15 the interoffice technical coordination group, how many
16 people are involved in that?

17 MR. O'REILLY: Commissioner Rogers, it is around
18 10 or 12.

19 COMMISSIONER ROGERS: Total?

20 MR. O'REILLY: Correct. We have several
21 representatives from each office and from each branch within
22 the office that deals with PRA or performs the risk
23 assessment of events on a daily basis.

24 COMMISSIONER ROGERS: Is that a fixed collection
25 of people or do you designate people depending upon the

1 event?

2 MR. O'REILLY: Usually, it is the same group, but
3 the same group is doing the work internally anyway. If we
4 find that someone else is interested in the ASP methodology,
5 the application of the methodology, we reach out and bring
6 them in. But basically it consists of representatives from
7 the two branches in NRR who are using the ASP methodology in
8 their daily assessment of events, staff from our branch in
9 AEOD and staff from the PRA branch in research.

10 COMMISSIONER JACKSON: I noted that you mentioned
11 and you have on your slide that the models and methods
12 development is now centered in research, and you have been
13 talking about the interoffice technical coordination group.
14 I guess the question I would have is, is there coordination
15 at high levels between the offices in terms of looking at
16 not just ASP but looking at it within the context of PRA and
17 its propagation throughout the agency, and that there is
18 consistency of approach and standards?

19 MR. JORDAN: I would say yes, and I would ask my
20 associates.

21 COMMISSIONER JACKSON: Who comprises that group?

22 MR. JORDAN: The three of us, in part, and then
23 our division director and branch chiefs are involved in the
24 PRA Program plan development. So these things are flowing
25 very, very nicely from top level management.

1 COMMISSIONER JACKSON: And the three of your are
2 working together in developing this overall PRA framework
3 for the agency?

4 MR. JORDAN: Yes.

5 MR. THADANI: Yes.

6 COMMISSIONER JACKSON: Okay. I am going to put
7 you on the record on that.

8 COMMISSIONER ROGERS: One could ask a nasty
9 question like when was the last time you met together?

10 COMMISSIONER JACKSON: I am not even going to do
11 that.

12 MR. JORDAN: What we have is a working group that
13 meets, what did you say, monthly, Pat?

14 MR. BARANOWSKY: The PRA coordinating?

15 MR. JORDAN: Yes.

16 MR. BARANOWSKY: Yes, monthly.

17 MR. JORDAN: And I called them a luncheon society
18 at one time, but I like it. They are close technically and
19 also organizationally, and that is who brought you the PRA
20 program plan and policy statement and gets coordination on
21 all PRA related activities. So I identify it as a model in
22 your shop.

23 MR. O'REILLY: To continue, in the area of new
24 model development, we developed a set of simplified plan-
25 specific models which were used for the first time in the

1 ASP Program in the analysis of 1994 events. We made several
2 improvements to models and methods. We are constantly
3 striving to obtain models or develop models that are more
4 realistic.

5 May I have the next visual, please?

6 MR. JORDAN: Could I back up a little to the
7 models, and we sort of urged Pat to rush through that. I
8 would want to state that the models, although they are not
9 detailed PRAs, we do have a site-specific model for every
10 site. So it is I think a reasonable level of detail with
11 respect to the plant configurations now, whereas when we
12 started the program they were extraordinarily generic and
13 broad models that had to be tuned each time you used them
14 for a specific plant. So I think that is a very beneficial
15 improvement.

16 COMMISSIONER ROGERS: Did you say you have one for
17 every plant now?

18 MR. O'REILLY: Every site.

19 COMMISSIONER ROGERS: Every site.

20 MR. O'REILLY: Right. We have 75 plant specific
21 models. We have one for every site. Obviously, for
22 Millstone we have three models.

23 One other thing I would like to add to Ed's
24 comment there, and that is, we are striving for realism. In
25 the comments that we receive from licensees, oftentimes they

1 refer to their own PRAs or their IPEs in generating their
2 comments, and the PRA/the IPE has been a very useful tool.
3 That is one of the improvements that we are making to
4 existing models. We reviewed IPE results to see if any
5 equipment that had not previously been included in our
6 models had been added to the plant as a result of an IPE,
7 and we have identified those and those will be incorporated
8 in the models in the future.

9 For 1995, we are implementing a new strategy to
10 improve the timeliness of the final ASP analyses being
11 available generally. What we are doing is, the preliminary
12 analysis will be performed as usual. We will send the
13 analysis out to the licensee, the staff, and to our
14 contractor for comment. As soon as we receive the comments
15 from those sources, we will develop and complete the final
16 analysis.

17 At that time, we will send it to the licensee for
18 their information and release it publicly. So these will be
19 done on an individual basis rather than waiting until the end
20 of the fiscal year and putting together a large report. At
21 the end of the year, when it is time for us to report to you
22 on the status of the ASP Program, we will simply compile the
23 final analyses that we have sent out during the last 12
24 months and put a cover on it and issue that as a NUREG CR
25 report.

1 COMMISSIONER JACKSON: So this is going forward
2 change?

3 MR. O'REILLY: Yes, it is. We hope to reduce the
4 time between an event's occurrence and when the final
5 analysis is issued from the current 10 to 22 months to six
6 to eight months.

7 COMMISSIONER JACKSON: That would also be
8 particularly important if you could also add on to it any
9 generic implications, because if there are, you would want
10 to get those out.

11 MR. JORDAN: Exactly, yes. We learned a lot
12 lessons out of the Shearon Harris event popping up because
13 it popped up in the contractor's report. We said, well,
14 what was Shearon Harris. So we really need to have that
15 kind of information in real time and that is one of the
16 reasons for moving this up to a very short response time.

17 MR. THADANI: And a few other plants actually have
18 the same miniflow design. So we did followup on that for
19 those plants.

20 COMMISSIONER ROGERS: Well, that is quite a
21 significant change in timing. What makes it possible for
22 you to do that? I mean, do you have to add more people?
23 Does this maturation of your PRA models make it possible to
24 do that? It is a big jump from six to eight to 10 to 22.

25 MR. JORDAN: Right. I would say that 1995 was a

1 high spending year with regards to ASP because we both
2 filled in the two missing years, and you might say we did
3 analyses for 1994 and started 1995. So we got spending
4 support from the Commission and the EDO to move it up in
5 that fashion. So we put more contractor work on it and more
6 staff work on it. The cost subsequently will be equal to or
7 less than, once we have gotten back to equilibrium.

8 MR. BARANOWSKY: Plus we did a critical path
9 analysis, if you will, of our whole process, and looked for
10 dead bands and eliminated them, or we are trying to
11 eliminate them.

12 MR. O'REILLY: May I have the next visual, please?

13 Finally, a word about future plans. The future
14 plans for the ASP program include continuing efforts to
15 shorten the time between the occurrence of the event and the
16 availability of the final analysis. We want to incorporate
17 the estimation of consequences into the ASP quantification
18 process. That is scheduled now for some time late in 1997.

19 We want to improve the analysis capability so that
20 the ASP Program can look at and consider uncertainties,
21 support systems independencies. We want to improve the
22 treatment of common cause failure and improve the analysis
23 of human performance during recovery. Those are scheduled
24 to be completed and incorporated in the models sometime in
25 1998.

1 COMMISSIONER JACKSON: Let me ask you a little bit
2 of questions on the uncertainties. The uncertainties and
3 incorporating them into quantification depends on many
4 things.

5 MR. O'REILLY: That's right.

6 COMMISSIONER JACKSON: Updated data, it depends on
7 the models you use. It depends on what kind of statistics
8 you use. Can you comment a little bit about that?

9 MR. O'REILLY: Well, this particular uncertainty
10 that we are talking about here is parameter uncertainty and
11 the basic events that are in the models. There is also
12 process uncertainty which is related to how you perform the
13 analysis.

14 COMMISSIONER JACKSON: What kind of statistical
15 distributions do you end up using?

16 MR. JORDAN: Currently we are using point
17 estimates in our analysis.

18 COMMISSIONER JACKSON: I see, so you use point
19 estimates.

20 MR. JORDAN: But I believe we go into some sort of
21 a Bayesian update approach.

22 COMMISSIONER JACKSON: Right.

23 MR. JORDAN: And exactly what distributions we
24 would use, I can't say but they would probably be
25 empirically derived.

1 COMMISSIONER JACKSON: Because those
2 distributions, as you are doing your update, your Bayesian
3 update, it is model-dependent, but we can talk about that as
4 a separate topic. You should know, I gave a talk at MIT
5 recently on PRA, and so I have been digging into this. That
6 makes a Commissioner or Chairman very, very dangerous.

7 MR. JORDAN: Well, I have to tell an anecdote
8 about the risk values and the uncertainties with the Wolf
9 Creek event, and my staff will cringe. I asked, once we had
10 established that this seemed to be a pretty bad event, to
11 get a preliminary estimate. So there was an awful lot of
12 foot shuffling. Finally, the staff came back and said,
13 well, it was somewhere between 10 to the minus 2 and 10 to
14 the minus 5. I said, well, everything is. But we finally
15 did get to a value.

16 MR. O'REILLY: The last two points, we also want
17 to include the capability to analyze shutdown and low-power
18 events. We have a development effort underway now. That
19 should be completed, and we will be able to incorporate the
20 methods into our models in early 1998.

21 We also want to have the capability to analyze
22 external events and conditions or, rather, the
23 vulnerabilities to certain conditions such as fires, floods
24 and seismic events. That is also underway and is scheduled
25 to be completed in mid-1998.

1 COMMISSIONER JACKSON: Let me walk you through a
2 couple of questions I have. Has the ASP Program identified
3 any previously unrecognized vulnerabilities that could lead
4 to a core damage accident?

5 MR. O'REILLY: I think you could point to the
6 Shearon Harris event as one example and Wolf Creek also.

7 COMMISSIONER JACKSON: And is there a process for
8 having any specific information that comes out of these
9 analyses fed back to inspectors?

10 MR. THADANI: There have been isolated cases where
11 things have come out and they have been fed back into the
12 inspection procedures, particularly if something important
13 comes out. Sometimes what we do is, in order to make sure
14 there is heightened awareness, we issue what we call
15 temporary instructions, and they would highlight what the
16 issue were, what we found, and why it was important for the
17 resident inspectors to go take a look at certain areas.

18 COMMISSIONER JACKSON: It is kind of on a judgment
19 basis at this point as opposed to some specified
20 methodology?

21 MR. THADANI: It is largely on a judgment basis,
22 that's right.

23 MR. JORDAN: I would add that the training program
24 accepts the precursor events and then uses it in subsequent
25 training as these are events of interest and are significant

1 from the standpoint of risk to utilities.

2 COMMISSIONER JACKSON: Right, but no specified
3 methodology at this stage for feedback?

4 MR. JORDAN: No, but I think we still may be
5 underplaying it because when my office or NRR meet with
6 resident inspectors on a periodic basis, we discuss and we
7 have, for instance, discussed in great detail the Wolf Creek
8 event. The Wolf Creek event I discussed at a senior
9 management meeting among the senior management, so those are
10 feedback.

11 COMMISSIONER JACKSON: That leads me naturally to
12 my next question, and that is, how is the ASP information
13 used in the plant performance reviews in SALP and in the
14 senior management meeting process?

15 MR. THADANI: At all the screening meetings, first
16 of all, that we have prior to our senior management
17 meetings, there is explicit identification of any precursor
18 events and how significant they were. So that is an input
19 to the process that tries to integrate a lot of information
20 in arriving at some judgments about the plant.

21 I would say that senior management probably pays,
22 in a way, much more attention to that information than in
23 terms of the large staff level. I think we need to do
24 better in that area. But management does focus in on the
25 insights that come out of these evaluations.

1 The other issue we are trying to make sure we push
2 is the timing because it is important to react relatively
3 quickly, particularly if they are significant events. So we
4 get out staff and management discussions going once a week
5 to try to get those aspects understood and followed up on.

6 COMMISSIONER JACKSON: Because you mentioned
7 methodology for sort of informing the industry if there are
8 generic issues, but it strikes me that if they are generic
9 issues that relate to unavailability of certain systems that
10 it is important that the people who are out where the rubber
11 meets the road have that to focus on.

12 MR. THADANI: Yes. If I can give you an example,
13 it doesn't always happen that way, but occasionally if we
14 find an issue is pretty significant, and the one that comes
15 to mind is, in 1987, Diablo Canyon midloop problems, and
16 that is the first time we really understood the significance
17 of what was happening because we did a number of internal
18 thermal hydraulic analyses to see what could happen under
19 different sets of conditions, and so on, and we did do a
20 precursor-type analysis as well.

21 At that point we thought it was so significant and
22 because the various groups get involved, particularly the
23 control room people, operators really need to know what is
24 going on in the plant at all times including during shutdown
25 if testing is going on, do they know what is happening to

1 the plant. We prepared letters that were signed, then
2 Director of NRR was Tom Murley, letters that he signed out
3 to individual operators just to try to make sure. They are
4 the ones who are right on the front lines, they need to
5 understand the significance of some of these things. That
6 is an example.

7 We have done that on occasion. We did it on
8 online maintenance as well. There have been a few examples
9 like that.

10 COMMISSIONER JACKSON: I noted that one of the
11 objectives of the ASP Program, you say, is to provide a
12 check with PRAs. How, in fact, do ASP Program results
13 compare with IPE results?

14 MR. O'REILLY: Pat, that seems like a question you
15 should answer.

16 MR. BARANOWSKY: Good. Actually, what we have
17 seen is accident sequences that are fairly representative of
18 what PRAs have predicted, but we don't always see the stack
19 up in terms of importance as being the same, for one.

20 A second thing is, the ASP events usually are
21 identifying unique ways in which these sequences can occur
22 that are not always evident by putting together the block-
23 by-block models that you see from IPEs or PRAs.

24 So, what we try to do is to make sure that the PRA
25 people are aware of ASP results and the characteristics, not

1 just the numbers, but the characteristics of the events, and
2 we have had some meetings in which we have talked with PRA
3 practitioners and the ASP folks to exchange information. We
4 have had at least a couple of them over the last three or
5 four years. Generally, we think that the availability of
6 the report and the insights which is widely distributed is
7 used based on just general talking to the people that are in
8 the PRA community.

9 COMMISSIONER JACKSON: Do you have any consistent
10 way to feed the information back?

11 MR. BARANOWSKY: I don't know that there is a
12 document that I could point to that says, here is the
13 insights.

14 COMMISSIONER JACKSON: Last question, as the
15 facilities get older, we have been talking and the
16 maintenance rule is oriented to this, the effect of
17 component degradation on performance, but it is also not
18 just aging, it has to do with maintenance. Are there
19 efforts to enhance ASP Program capabilities in this area?

20 MR. O'REILLY: Do you mean to look for aging
21 effects?

22 COMMISSIONER JACKSON: Well, the effect of
23 component degradation and how that plays into it?

24 MR. BARANOWSKY: I think ASP represents sort of a
25 sample and a sparse sample of experience because we are only

1 looking at the incidents that occur in combinations, and
2 they are fairly rare. The system and equipment reliability
3 work that we are trying to do, and AEOD would address, I
4 think, the concerns that one has about the performance of
5 equipment and systems over time and whether or not they are
6 changing. We would need a higher data density in order to
7 detect that stuff in a timeframe that would be consistent
8 with us taking a regulatory action or finding insights that
9 we could use.

10 COMMISSIONER JACKSON: Are you able to take into
11 account equipment interaction, I mean, as opposed to an
12 availability/non-availability as it relates to the
13 degradation issue?

14 MR. JORDAN: Yes, I would comment and say that the
15 equipment itself, the safety system equipment is better off
16 than it was a few years ago because of the maintenance
17 activities, the utilities recognition, and the initiators
18 are down. So I am searching back to identify where we are
19 seeing now age related ASP insights, and I don't see much
20 there.

21 COMMISSIONER JACKSON: So you haven't noted any
22 particular correlation between aging and the number of
23 precursors that are due to equipment unavailability?

24 MR. JORDAN: No, I don't think so.

25 COMMISSIONER JACKSON: I said that was the last

1 question, but I do have one more. I note in your own
2 documentation you note, when you looked at the Shearon
3 Harris case, that the ASP models do not really currently
4 address the potential of secondary side depressurization in
5 this particular case in low-pressure injection for core
6 cooling success. Is that a kind of thing that is worth
7 considering?

8 MR. O'REILLY: Yes, it is. We currently are
9 working so that our models will have the ability to do that.
10 In the past, when we received comments from utilities, and
11 that has been going on since 1992, that was one of the
12 recovery methods that several utilities claimed for their
13 particular event that they were dealing with. We were only
14 able to model it in a very coarse way.

15 COMMISSIONER JACKSON: Right. You just put in a
16 probability for it.

17 MR. O'REILLY: Right. That was when we were using
18 the event trees solely. Now we have event trees and we use
19 the fault tree linking methods to get a more realistic view
20 of the plant's response, and it will enable us eventually to
21 do something about this deficiency that we have had.

22 COMMISSIONER JACKSON: If you are going to look at
23 failure to recover from or recovery from, then that has
24 significant potential impact, but it also shows where human
25 reliability comes into play.

1 MR. THADANI: That's correct. In fact, that was
2 an issue on one precursor analysis where if you took credit
3 for secondary site cooling it would make a significant
4 enough difference.

5 COMMISSIONER JACKSON: That is assuming that the
6 human factors were --

7 MR. THADANI: That is what would control it,
8 exactly right.

9 I would like to go back to your earlier question,
10 just a little caveat. I am probably a little more concerned
11 about aging effects and making we are seeing some precursors
12 or some problems, I think, not that they are quantified. I
13 look at boiling water reactor internals and we are seeing
14 cracking of certain components. I see steam generator
15 tubes, we are seeing new degradation mechanisms. I think
16 what it means is that certainly the margins are probably not
17 where we thought they were at one point. How significant is
18 that, I think, remains to be seen.

19 Part of the difficulty, I think, in the technology
20 in terms of the probabilistic assessments, we are not there,
21 I don't believe, to draw some firm conclusions.

22 COMMISSIONER JACKSON: I will smile at Dave
23 Morrison as you say that.

24 DR. MORRISON: There is a lot to be done.

25 MR. THADANI: Yes.

1 MR. BARANOWSKY: Some of the more recent precursor
2 results have been at the older plants, but let's also
3 recognize that the more recent precursor results have not
4 been as significant as the ones that occurred 15 or 20 years
5 ago when we were really concerned. So it is hard to say
6 whether that is degradation or just the old plants at their
7 level of performance. That is why I was not able to detect
8 it.

9 COMMISSIONER JACKSON: Commissioner Rogers?

10 COMMISSIONER ROGERS: Yes. A couple of things
11 just on this, and then a few general questions.

12 I wonder if you could go back to the consequences
13 question, the second bullet. Could you elaborate a little
14 bit about what you are thinking about there? You are not
15 talking about Level 3 PRAs on this?

16 MR. O'REILLY: No. What we are trying to do is
17 get a very simple yet efficient way of getting a handle on
18 consequences. We don't envision a detailed Level 3 PRA. We
19 are looking for some way to transform from Level 1 results
20 to the point where we could get some sort of consequence
21 bands, or consequence regions, if you want to call them
22 that, and it is just in the infancy right now. But we are
23 not trying to reinvent the wheel because the models we have
24 are simplified plant models. They are not as detailed as a
25 PRA would be.

1 MR. BARANOWSKY: I think we foresee having some
2 BINS and some guidance as to how to put the events into
3 damage states, if you will, that could be related to
4 releases without doing the detailed Level 2, 3, types of
5 analyses.

6 DR. MORRISON: I might comment that we did take a
7 look at the kind of modelling that would be required to do
8 that, and we had a feasibility study this past fiscal year
9 which did indicate that there were some feasible approaches
10 and so we will be trying during this next fiscal year to see
11 if that can't be implemented into the broader methodology
12 and look at things like what is the containment failure,
13 what is the possibility of health-effects aspects of it, so
14 that it does move more towards the risk side rather than
15 just simply the conditional core damage failure.

16 COMMISSIONER ROGERS: And this presumably would be
17 useful also as management guide for licensees.

18 DR. MORRISON: I certainly would hope so because
19 if you overlook what is happening in the secondary side and
20 in the containment, there is a big gap.

21 COMMISSIONER ROGERS: Just coming back to the
22 human performance analysis that you want to incorporate more
23 fully, will you need additional information, additional data
24 and, if so, how will you get that to do these?

25 MR. O'REILLY: We are coming up with an approach

1 which, unfortunately, tends to be very subjective if you
2 don't have the detailed information. We are in the same
3 boat you would be in no matter what when you are talking
4 about trying to improve the analysis of human performance.
5 So is there enough detail in what we get now? Some there
6 are and some don't have it. I am not really sure how to
7 answer your question.

8 COMMISSIONER JACKSON: Well, one way to get at it
9 would be, are the models sufficiently developed that you
10 know what data would improve your uncertainty bands, would
11 narrow them, in your analysis in cases where you have to
12 worry about human performance?

13 MR. BARANOWSKY: The models are simple, but they
14 reflect our best understanding of the factors that shape
15 human performance, and we have default values which, if we
16 don't have information on how to adjust the parameters, we
17 would use them and that would make the analysis more
18 uncertain.

19 On the other hand, we do contact licensees and
20 sometimes extensively to discuss events in order not to have
21 an overly conservative or an improper underestimate of the
22 likelihood of human performance.

23 But certainly our models suffer from the same
24 limitations that the PRA state-of-the-art does in human
25 reliability analysis anyhow. so I think it is not on the

1 edge of the state-of-the-art, not advancing it, but it is
2 using the things that have been more or less understood and
3 I will call "proven."

4 COMMISSIONER ROGERS: So you are doing the best
5 you can, really, with what you have got?

6 MR. BARANOWSKY: That's right.

7 DR. MORRISON: Well, this is an important area
8 within research to try to get a better understanding of the
9 human reliability. I wouldn't be surprised at the end of
10 the day considerably more data are going to be required.

11 COMMISSIONER ROGERS: Absolutely.

12 MR. THADANI: We had at least two distinct areas,
13 actually the three officers, we had a meeting not too long
14 ago after the last senior management meeting where we
15 discussed some of the personnel errors at Cooper as well as
16 at River Bend, and we had a heck of a time trying to take
17 that information and try to quantify it, and we realized we
18 didn't know how to do it. So we had a meeting with Dave and
19 others to make sure, how can we go forward in research as a
20 task to see how those types of personnel errors -- these
21 were not necessarily operators in the control room,
22 nevertheless, they had an impact on safety. That is one
23 area.

24 The other area, as I think, Commissioner Rogers,
25 you have been briefed on before, is the organizational

1 factors impact, and that is a complex area. That is going
2 to be a while.

3 COMMISSIONER JACKSON: Even if you could just
4 migrating from personnel areas of a given type in terms of
5 their implication for given accident sequence and somehow
6 figuring out a way to incorporate to see how that changes
7 your guesstimate would be an important step forward, it
8 strikes me.

9 COMMISSIONER ROGERS: I think you have to inch
10 ahead here on this, and it sounds to me like you are doing
11 what is reasonable. The organizational one, I don't think
12 we want to talk about that today. That is a tough one.

13 I wonder, what is the relationship of this program
14 now to the need for the data from the proposed reliability
15 data rule? In other words, in refining this ASP Program --
16 and I don't like ASP, that gives me a bad connotation, I can
17 only think of Cleopatra -- but, at any rate, the reliability
18 data rule or proposed reliability data rule, how does that,
19 the kinds of data in that rule, relate to your thoughts
20 about improving the ASP Program?

21 MR. BARANOWSKY: The data would be used to improve
22 what I have called the standing system reliability models
23 that would be in the ASP methodology, and they would also
24 provide the ability to look at trends amongst equipment that
25 couldn't be seen because of the rarity of ASP events. So it

1 would be a way to improve the accuracy of the models in
2 terms of our baseline that we start with when we look at
3 events, and then it supplements ASP's snapshots of rare
4 events by giving us some trends in-between these things. We
5 might not see an event at a plant that involves auxiliary
6 feedwater for four or five years, which doesn't mean that
7 there aren't some conditions going on at the plant that
8 indicate auxiliary feedwater degradation. So it is really
9 complementary and also a part of the baseline, if you will,
10 of the model.

11 COMMISSIONER ROGERS: Well, it sounds like it is
12 important.

13 MR. BARANOWSKY: I think it is.

14 COMMISSIONER ROGERS: I think you have touched on
15 it, but I wonder if you might want to say anything else
16 about how this program is helpful in our improving how we
17 regulate? What are the consequences of this so far in how
18 we do our job as regulators? We are starting to look at
19 everything we do through the Chairman's rebaselining effort,
20 but are there any perceptions that you have with respect to
21 already the effect of this program on our regulatory
22 procedures or emphasis?

23 MR. THADANI: Let me say a few words, at least,
24 from an NRR perspective. We think this program is extremely
25 valuable. It has helped us many times in terms of our

1 discrimination of events and their importance, what
2 resources we should be applying in terms of followup of
3 these activities. You have heard some examples here.

4 I think that, in itself, is absolutely invaluable,
5 that we are doing a much better job of putting our resources
6 on more important issues than I think we were doing before.
7 This program plays an important part in those decisions.

8 I might add, in 1987, NRR took a very strong
9 position that is a very valuable program, we really want to
10 make sure there is agency support, interoffice support for
11 this program, because most of our activities are really
12 oversight of operating reactors. Design certification is
13 sort of going away, and this is probably one of the more
14 useful tools in us being able to discriminate what we should
15 do.

16 I don't mean to say just point estimates, but
17 broadly speaking, more important, less important, plant-
18 specific versus generic implications, it helps, I think, and
19 to me that is invaluable.

20 COMMISSIONER ROGERS: Well, I have been very
21 pleased to see the development of the program and we are
22 coming to that conclusion that it is very helpful. But when
23 you get to a situation like that, now you have to start to
24 begin to think about how far is far enough. It is an
25 excellent program, it looks like it has great potential for

1 additional improvements. But now, it seems to me, is the
2 time to start thinking about where will we decide and can we
3 begin to identify how far we ought to go but probably no
4 further than that. Again, it is going to be a resource
5 question. So that when you get a hold of something that
6 seems so good and tastes so good, it is time to start
7 thinking about, what bounds do you put on this.

8 MR. JORDAN: I do have a ready answer for that.
9 Ideally, it would go away in terms of a tool that the NRC
10 would have to apply primarily, and that it would become a
11 tool that the industry would apply for each event so that a
12 they screen and review their events, if they reported to us
13 a conditional core damage probability using their IPE, their
14 more plant-specific PRA, that would be a much better process
15 than for the NRC to do it, and cause them to do a peer
16 review based on their PRAs.

17 So if I were making a long-term projection of
18 where I would like to be, it would be reviewing a utility
19 submittal of the risk of their events. We have to maintain
20 a methodology to review because it does take several cuts at
21 these events to try to see and find the real important ones,
22 but that is the ideal I would be headed towards.

23 COMMISSIONER JACKSON: But, if you were going to
24 apply it in such a review, this connection or the insight it
25 gives you into IPEs and utility PRAs --

1 MR. JORDAN: Right a living PRA arrangement.

2 COMMISSIONER JACKSON: Right.

3 COMMISSIONER ROGERS: Well, it sounds like that is
4 something that we ought to be starting to talk to the
5 industry about.

6 MR. THADANI: I would just note that the comment
7 that you made about ASP is really applicable to all of the
8 activities related to the use of probabilistic techniques.
9 That, to a certain extent, we are also trying to make sure
10 we integrate these concepts and ideas. That is why we
11 developed the plan the way we did.

12 COMMISSIONER ROGERS: Well, I would just like to
13 say, I have enjoyed this enormously. I thought it was an
14 excellent presentation.

15 MR. JORDAN: I want to thank you for this update.
16 You know, I have previously mentioned in some of my speeches
17 that I believe that the capability of this agency to
18 effectively accomplish its mission is in part based on our
19 ability to do performance and risk-based assessments, and I
20 believe that as a learning organization that the review and
21 analysis of risk significant accident sequences is an
22 integral part.

23 I think continued refinement is important, and
24 thinking of where the appropriate transfer points are in
25 terms of how the industry might make use of what we do, but

1 also how it informs our day-to-day activities, because then
2 when it is proliferated in that sense, then that is when one
3 is getting the most effectiveness out of that.

4 Unless you have any further closing comments,
5 thank you very much.

6 [Whereupon, at 11:18 a.m., the meeting was
7 concluded.]

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CERTIFICATE

This is to certify that the attached description of a meeting of the U.S. Nuclear Regulatory Commission entitled:

TITLE OF MEETING: BRIEFING ON ACCIDENT SEQUENCE
PRECURSOR PROGRAM - PUBLIC MEETING

PLACE OF MEETING: Rockville, Maryland

DATE OF MEETING: Wednesday, November 15, 1995

was held as herein appears, is a true and accurate record of the meeting, and that this is the original transcript thereof taken stenographically by me, thereafter reduced to typewriting by me or under the direction of the court reporting company

Transcriber: Jessie Munson

Reporter: Mark Mahoney



ACCIDENT SEQUENCE PRECURSOR PROGRAM

**November 15, 1995 Commission Briefing
Office for Analysis and Evaluation of Operational Data**

AGENDA

- **Background**
- **1994 ASP Results**
- **Overview of Commission Paper on ASP Program Status**

OBJECTIVES OF THE ASP PROGRAM

- **Identify and Rank Risk Significance of Operational Events**
- **Determine Generic Implications of an Operational Event/
Characterize Risk Insights**
- **Provide Supplemental Information on Plant-Specific
Performance**
- **Provide a Check with PRAs**
- **Provide an Empirical Indication of Industry Risk and
Associated Trends**

DEFINITIONS

- **Accident Sequences of Interest** - Those sequences that, if they had occurred, would have resulted in inadequate core cooling and potentially severe core damage
- **Accident Sequence Precursors** - Events or conditions that are important elements in the above sequences (e.g., an unusual initiating event or failures of multiple components that, when coupled with one or more postulated events, could result in a plant condition leading to severe core damage)
- **Containment-Related Events**—Failures that could result in reduced containment performance (e.g., unavailability of a containment cooling, containment spray, or post-accident hydrogen control).

HISTORICAL BACKGROUND

- **Program Started in 1979 in Response to Peer Review of WASH-1400; First Reports Developed and Issued by RES; ASP Program Transferred to AEOD in 1985**
- **More Than 50,000 LERs Processed, and 583 Precursors Identified.**
- **Precursor Reports Covering the Years 1969-79, 1980-81, and Every Year Since 1984**
- **Review and Analysis of 1982-83 LERs for Precursors Underway at Sandia National Laboratories (SNL)**



HISTORICAL BACKGROUND

IDENTIFICATION OF SIGNIFICANT PRECURSORS (CONTINUED)

- Yearly Monitoring of Precursor Events after 1984:**

<u>Year</u>	<u>Plant</u>	<u>Description</u>	<u>CCDP</u>
1984	La Salle 1	Error Caused Scram, RCIC Failed, RHR Valve Failed Closed.	2.3×10^{-3}
1985	Hatch 1	HVAC Water Shorted Panel, Safety-Relief Valve Failed Open, HPCI Failed, RCIC in Maintenance	1.8×10^{-3}
1985	Davis-Besse	Loss of All Feedwater, Stuck-Open PORV	1.1×10^{-2}
1986	Turkey Point 3	Load Loss, Manual Trip, Control Rod Drive Auto Insert Failed, PORV Stuck Open	1.4×10^{-2}
1990	Vogtle	Loss of Offsite Power, Both Emer. Diesel-Generators Inop.	1.0×10^{-3}
1991	Shear.Harris	High Pressure Injection Unavailable 1 Fuel Cycle	6.3×10^{-3}
1994	Wolf Creek	Reactor Coolant System Blowdown during Shutdown	3.0×10^{-3}

OVERVIEW OF ASP SCREENING, REVIEW, AND ANALYSIS PROCESS

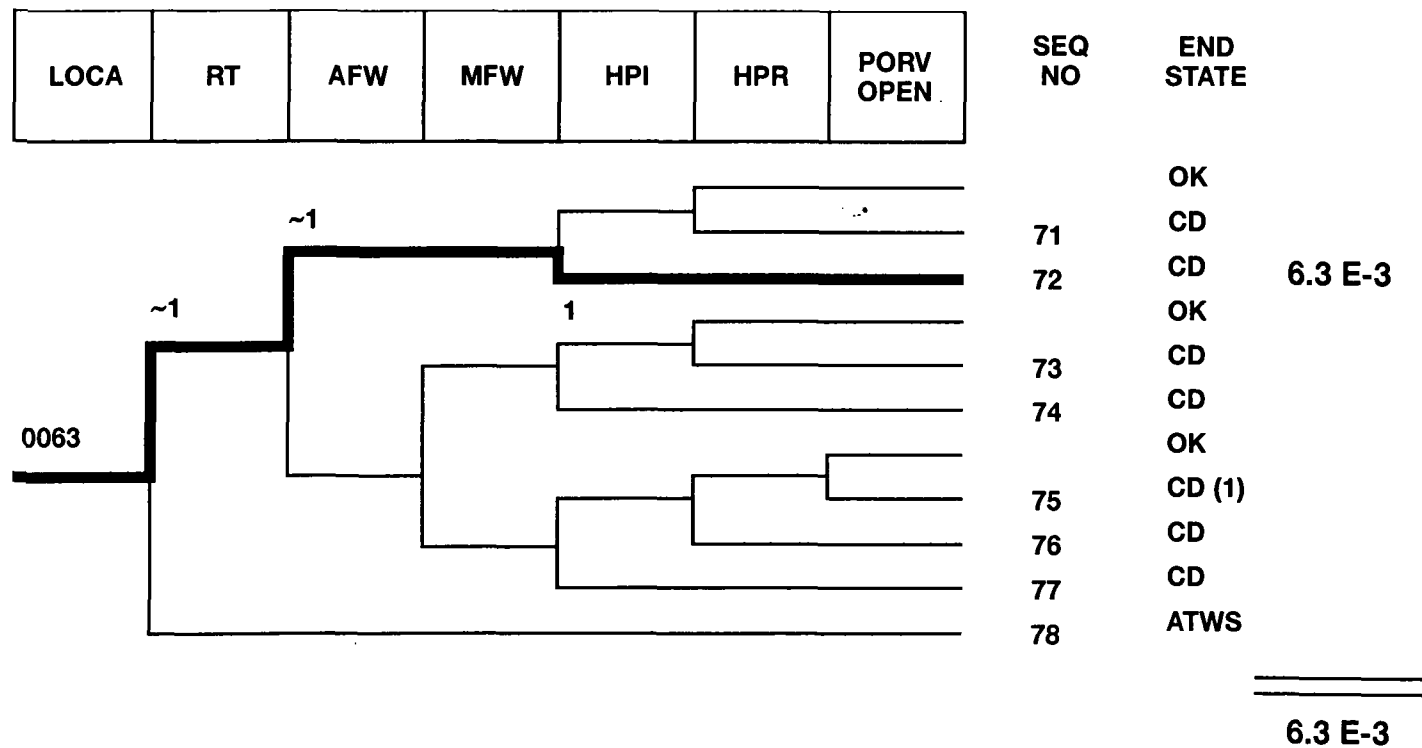
- **Screening of LER Database by Sequence Coding and Search System (SCSS) Algorithm**
- **Other Sources of Candidate Precursors**
 - Incident Investigation Team (IIT) or Augmented Inspection Team (AIT) review
 - Significant Events
 - NRC's daily screening of operational events
 - NRR's prompt event assessments
 - Events identified by NRC staff as candidates, regardless of method of documentation (e.g., inspection report, 10 CFR 50.72 report)
- **Engineering Review of Screened Events**
- **Detailed Analysis and Quantification**
- **Licensee, NRC Staff, and Independent Contractor Reviews**
- **Final Analyses Published in Annual Precursor Report**

LER No: 400/91-008

Event Description: HPI unavailability for one refueling cycle because of inoperable miniflow lines

Date of Event: April 3, 1991

Plant: Harris 1



1994 AT-POWER PRECURSORS INVOLVING UNAVAILABILITIES

<u>PLANT</u>	<u>CCDP</u>	<u>DESCRIPTION</u>
Haddam Neck	1.4×10^{-4}	Power-Operated Relief Valves and Vital 480-V ac Bus Degraded
Zion 2	2.3×10^{-5}	Unavailability of Turbine-Driven Auxiliary Feedwater Pump and Emergency Diesel-Generator
Point Beach 1 and 2	1.2×10^{-5}	Both Diesel-Generators Unavailable
Dresden 2	6.1×10^{-6}	Motor Control Center Trips Due to Improper Breaker Settings

1994 AT-POWER PRECURSORS INVOLVING UNAVAILABILITIES (CONTINUED)

<u>Plant</u>	<u>CCDP</u>	<u>Description</u>
Dresden 2	3.1×10^{-6}	Long-Term Unavailability of High Pressure Coolant Injection
Turkey 3 and 4	1.8×10^{-6}	Load Sequencers Periodically Unavailable

1994 AT-POWER PRECURSORS INVOLVING AN INITIATOR

<u>Plant</u>	<u>CCDP</u>	<u>Description</u>
River Bend	1.8×10^{-5}	Scram, Main Turbine-Generator Fails to Trip, Reactor Core Isolation Cooling and Control Rod Drive Systems Unavailable
Calvert Cliffs 2	1.3×10^{-5}	Trip, Loss of 13.8 Kv Bus, and Short-Term Unavailability of Saltwater Cooling System

1994 SHUTDOWN PRECURSORS INVOLVING AN INITIATOR

Wolf Creek	3.0×10^{-3}	Reactor Coolant System Blows Down to Refueling Water Storage Tank During Hot Shutdown
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SUMMARY OF INSIGHTS FROM 1994 ASP RESULTS

- **Wolf Creek Shutdown Event Was Highest Conditional Core Damage Probability Since 1991**
- **Majority of 1994 Precursors Involved Electrical Equipment Problems**
- **Conditions or Unavailabilities of Equipment Produced More Precursors than Initiators**
- **Number of Precursors Involving Initiators Continued to Decrease**

PROGRAM ACCOMPLISHMENTS

- **ASP Program Coordination**
- **Analysis of 1994 Operational Events**
- **Acceleration of 1995 Review**
- **ASP Analysis of 1982-83 LERs**
- **Evaluation of ASP Results and Trending**
- **Model and Methods Development – Now Centered in RES**
- **Development of New Models – Revision 1.0 Completed**
- **Improvements to Existing Models**

NEW APPROACH FOR IMPROVING TIMELINESS OF FINAL ASP ANALYSIS

- **Shorter Schedule for Resolution of Peer Review Comments and Final Analysis**
- **Goal - Final ASP Analysis of an Event Issued within 6-8 Months vs 10-22 Months**
- **NUREG/CR - Compilation of All Final Analyses Completed over Past 12 Months**

FUTURE PLANS

- **Continue to Reduce Time between Event Occurrence and Final Analysis**
- **Include Consequences in ASP Quantification Process**
- **Improve Analysis Capability to Incorporate:**
 - **Uncertainties in quantification**
 - **Support systems and other dependencies**
 - **Improved treatment of common cause failures**
 - **Improved human performance analysis during recovery**
- **Include Analyses of Shutdown/Low Power Events**
- **Include Analyses of External Events/Conditions**
 - **Fires**
 - **Floods**
 - **Seismic events**