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(202) 234-4433

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UNITED STATES OF AMERICA

NUCLEAR REGULATORY COMMISSION

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OFFICE OF NUCLEAR REGULATORY RESEARCH

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BRIEFING ON STATUS OF SECOND DRAFT OF NUREG-1150

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Nuclear Regulatory Commission
One White Flint North
Rockville, Maryland

Friday, May 5, 1989

The Commission met in open session, pursuant to notice, at 10:00 a.m., Lando W. Zech, Jr., Chairman, presiding.

COMMISSIONERS PRESENT:

Lando W. Zech, Jr., Chairman of the Commission
Thomas M. Roberts, Commissioner
Kenneth C. Rogers, Commissioner
James r. Curtiss, Commissioner

STAFF:

Denny Ross
Victor Stello
Mark Cunningham
John Hoyle
Erick Beckjord
Joseph Murphy
Joseph Scinto

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

2 (10:00 a.m.)

3 CHAIRMAN ZECH: Good morning, ladies and
4 gentlemen. Commissioner Carr will not be with us
5 today.

6 This is an information briefing which the
7 staff will provide the status of the second draft of
8 NUREG 1150, Severe Accident Risks, an assessment for
9 five US nuclear power plants. NUREG 1150 was
10 published as a draft for comment in February 1987.
11 Extensive public comments were received. In addition,
12 the draft document has been subjected to three
13 independent peer reviews. And the staff received
14 comments from the international community. The staff
15 has been in the process of improving the report, to
16 address the comments received.

17 In December 1988, the staff briefed the
18 Commission on options for further peer review of NUREG
19 1150, the timing of release of the report and the
20 interim use by the staff.

21 Following this meeting the Commission
22 directed the staff to, first, form a new review
23 committee under the Federal Advisory Committee Act;
24 and second, to issue NUREG 1150, subject to prior
25 review by the Commission, as a second draft and NUREG

1 1150 could be used as a reference in the interim; and
2 three, issue the final NUREG 1150 report after the
3 final peer review committee's recommendations are
4 resolved, and after a final review by the Commission.
5 In March 1989, the staff briefed the
6 Commission on the improvements to NUREG 1150 and the
7 results pertaining to accident frequencies from
8 internal events.
9 Today's meeting will include discussion of
10 the improvements and results pertaining to the
11 remainder of NUREG 1150, as well as to the status of
12 the document itself.
13 In a briefing by the Advisory Committee on
14 Reactor Safeguards, on the 3rd of May 1989, the
15 Commission requested the ACRS to address the proposed
16 intended uses of NUREG 1150, while the report is
17 undergoing peer review. I understand that the staff
18 briefed the Advisory Committee on Reactor Safeguards
19 yesterday on the status of the second draft of NUREG
20 1150 and the intended uses. And we expect to hear
21 from the ACRS on their views shortly.
22 When this peer review has been completed and
23 NUREG 1150 is published as a final document, we expect
24 that it will represent a major advance in the
25 methodology for examining the risks associated with

1 five specific nuclear power plants, as well as the
2 uncertainties associated with those risks.
3 Copies of the slides should be available at
4 the entrance to the meeting room.
5 Do any of my fellow commissioners have any
6 comments before we begin?
7 (No response)
8 CHAIRMAN ZECH: If not, Mr. Stello, you may
9 proceed.
10 MR. STELLO: Thank you, Mr. Chairman.
11 We are continuing to work in setting up the
12 fact committee. We have some further details that we
13 need to deal with and are not prepared to tell the
14 Commission that is finalized today, but hopefully, in
15 the near future we will have that done. We are
16 working with the General Counsel's office and other
17 elements of the federal govenment to make sure that we
18 take all the steps that are proper in setting up the
19 fact committee and hopefully, we will have that --
20 COMMISSIONER ROGERS: Does that involve any
21 changes in the composition today?
22 MR. STELLO: No, sir; no, sir, procedure,
23 process. We do hope that -- and have tentatively
24 established, at least as a target, that the first
25 meeting, in fact, can take place in July. We still

1 believe that is doable and we are setting up -- it is
2 a procedural issue that we need to get through.
3 As we indicated in our last briefing, we
4 would go to the ACRS and tell the ACRS what it is that
5 we intended as the interim uses. The ACRS committed to
6 try to advise the Commission in time for it to have
7 that advice
8 -- the Commission have that advice before it finally
9 decides where we ought to come out on that issue. You
10 have our recommendations, of course, before you.
11 We met yesterday with the ACRS, and at least
12 we are hopeful that they will, in fact, provide you
13 with that advice. They are in session this weekend
14 and preparing letters. And I hope that we will see a
15 letter outlining their recommendations to you,
16 hopefully, early next week.
17 I don't have a firm commitment that they
18 will do that, but at least we are under the impression
19 they are going to attempt to try to provide advice on
20 this matter. I think it is a very important subject,
21 it sets the tone of what it is you do with this vast
22 amount of technical information that has been
23 developed now over these last 15 years. And I think
24 it is very, very important that we all go forward
25 knowing exactly how we intend to proceed in the

1 future, while the peer review is, in fact, going on.

2 As we have indicated, our intent would be to

3 have the peer review finished, get the results of the

4 peer review and then propose to the Commission a final

5 version that we would bring to the Commission and

6 suggest to the Commission that this is, in fact, now

7 the final package as it ought to go out. And that's

8 when the Commission of course would decide finally

9 what its views are on 1150.

10 CHAIRMAN ZECH: That's after this peer

11 review?

12 MR. STELLO: After the peer review, and

13 after we got the results of the peer review and had an

14 opportunity, if we need to modify, or change the

15 document in any way, to make those changes and then

16 bring it back to the Commission, after we have had a

17 chance to react and do whatever comes out of the peer

18 review that seems appropriate to do.

19 CHAIRMAN ZECH: Fine.

20 MR. STELLO: There is one issue that I did

21 mention at the last meeting that, again, I think is

22 important. And you will be hearing more of it again

23 this morning, and that's in the area of the seismic

24 risks. We will be providing you with the core melt

25 frequencies, including internal events, seismic as

1 well as fires. The difficulty we have though is, as
2 you are aware, nuclear facilities are, in fact, very,
3 very robust, they are designed to very, very high
4 seismic standards, so that when you get to the point
5 where a nuclear facility is postulated to fail, as a
6 result of the seismic challenge, those particular
7 seismic challenges are indeed very, very remote.
8 We are talking about events that are from a
9 .5 g to 1.23 g, in terms of the challenge to the
10 facility, which is up to 10 times the design
11 requirements that we impose for earthquakes. So you
12 are way out on the spectrum.
13 The question then becomes well, what really
14 is the consequences of such a severe earthquake? You
15 can't just simply analyze it by looking at a
16 radiological consequence alone. You clearly have got
17 to ask the question for earthquakes even less severe
18 you have the potential for significant damage in the
19 vicinity. And hence, risk to the public that is going
20 to be there, even without a nuclear hazard present.
21 The studies that have been done do indicate
22 that the nuclear hazard is not significant and is not
23 controlling for these very large earthquakes. But
24 there is a great deal of work that needs to be done in
25 this area. And we are searching for how to be able to

1 present that kind of information. So we have done a
2 correct, thorough technical analysis and not tried to
3 deal with the problem in a vacuum.
4 We need to do more work on that. That is
5 not going to be done, prior to the peer review. That
6 is going to be something off in the future. We are
7 really opening up a very, very difficult area, in
8 terms of dealing with extreme seismic hazards. We
9 need to do a lot more in that area. We will, but it
10 is not going to be done before the peer review takes
11 place. In my judgment, I just don't think there is a
12 chance.
13 With that introduction, let me turn to Eric,
14 who has some comments.
15 CHAIRMAN ZECH: This is an earthquake that
16 is well above and beyond what we consider the design
17 basis earthquake?
18 MR. STELLO: Yes. Briefly, our design
19 basis, or so-called SSE, safe shutdown earthquake, is,
20 in fact, a very remote earthquake to begin with. A
21 very unlikely event.
22 COMMISSIONER ROBERTS: I think we are
23 talking about something that is --
24 MR. STELLO: Five to 10 times more severe
25 than even that.

1 CHAIRMAN ZECH: But the plants are designed
2 to accommodate an earthquake that, as far as we know,
3 reasonably might be expected in the area?
4 MR. STELLO: Well beyond that.
5 CHAIRMAN ZECH: Yes, but at least beyond--
6 at least up to that. And what you are talking about is
7 an earthquake that is way above that.
8 MR. STELLO: Much more severe -- that's
9 correct, much more severe. And the difficulty is --
10 COMMISSIONER ROBERTS: But much more
11 statistically --
12 MR. STELLO: Remote.
13 COMMISSIONER ROBERTS: Yes, that needs to be
14 constantly stated.
15 MR. STELLO: Yes, but the difficulty becomes
16 how do you calculate what the consequences of that
17 are. The reasoning is that you have a nuclear
18 facility which is designed in a far more robust
19 fashion than anything else -- we have far more
20 stringent standards for design for nuclear facilities
21 than you have for any other buildings, or structures,
22 or facilities in the surrounding populations. Those
23 clearly are going to create a consequence for
24 earthquakes much less severe than the earthquake that
25 we already design for a nuclear plant.

1 Now we are talking about earthquakes five to
2 10 times beyond that level of earthquake, which is
3 getting us out into an area where there is very little
4 work that has been done to truly understand what those
5 consequences are. You are going to have failures of
6 dams and buildings and pipelines, and chemical
7 processing -- you name it, with earthquakes much less
8 severe than the kind that we are talking about. We
9 need to do more work in that area.
10 CHAIRMAN ZECH: All right, fine. Thank you.
11 COMMISSIONER ROGERS: I don't want to get
12 into something that will come later, but I did have a
13 question later on for the differences between the
14 Livermore and EPRI models of these kinds of events.
15 And will that be addressed? Will you say something
16 about that?
17 MR. STELLO: Yes, we will, but I am beyond
18 that.
19 COMMISSIONER ROGERS: It's a different
20 question, but it is related to --
21 MR. STELLO: Agreed.
22 COMMISSIONER ROGERS: But beyond even that,
23 how do you calculate what the real consequences of
24 those earthquakes are, with either model?
25 CHAIRMAN ZECH: Let's proceed.

1 MR. STELLO: Eric.

2 MR. BECKJORD: Mr. Chairman, Commissioners-

3 -

4 CHAIRMAN ZECH: Yes, please proceed.

5 MR. BECKJORD: -- before you hear the report

6 on the findings of severe accident risks, I would like

7 to say a word about the effort involved in the

8 completion of the project and the people who have

9 contributed to it.

10 This has been a major research project and

11 the national laboratories: Sandia, Brookhaven, Idaho,

12 Los Alamos and Battelle Memorial Institute, and a

13 number of contractors have applied their skills to

14 completing the new draft. I would like to commend all

15 of them, and mention especially the program managers

16 at Sandia, which was the principal contributor, for

17 their dedication to completing this work, that is Mr.

18 Ortez, Elaine Burguron and Allen Capp. Dr. Burguron

19 and Dr. Capp are here with us today --

20 CHAIRMAN ZECH: Would you stand up, please?

21 Thank you very much, we appreciate you being with us

22 today, too.

23 MR. BECKJORD: And also Dr. Denning, Rich

24 Denning, from Battelle, who has played a very major

25 and significant role in this --

1 CHAIRMAN ZECH: Thank you very much.

2 MR. BECKJORD: The report is of high
3 quality. And I believe it will stand well the test of
4 reviews and of time. I note especially the expert
5 opinion and elicitation. This has been completely
6 revised in the past two years, and it is unprecedented
7 in scope. And I think it is a landmark
8 accomplishment.

9 The expert elicitation process and the
10 results have made it possible to respond to one of the
11 major criticisms of the 1975 Rasmussen Report, WASH
12 1400. That is that a careful determination of the
13 uncertainties and probabilistic risk assessment was
14 needed.

15 Finally, I would like to note the efforts of
16 the NRC Research Staff who have also worked with skill
17 and dedication on 1150. Dr. Ross has taken the
18 entire project, has exercised very careful oversight
19 over the entire project. Mr. Murphy and Mr.
20 Cunningham have been the project manager/leaders here.
21 And I believe that all who have contributed to this
22 effort can be very proud of their accomplishment.

23 CHAIRMAN ZECH: Thank you very much.

24 MR. ROSS: Okay, let's have our first slide,
25 please. (Slide) This is just a Table of Contents for

1 this morning's purpose: present status, risk
2 analysis, methods, perspectives and summary.
3 I will do the first part and then my
4 associate on the left, Mark Cunningham, will do the
5 last part. And I think the deputy division director of
6 the responsible division, Joe Murphy, who has had
7 recent eye problems, will chip in with answers,
8 although he will have a little difficulty with
9 reading, because of his eye surgery.
10 CHAIRMAN ZECH: Well, we hope you had a very
11 successful surgery, Joe.
12 MR. MURPHY: It was, it was.
13 DR. ROSS: Next slide, please. (Slide) The
14 purpose, as has been said -- we've already covered the
15 first bullet -- it is our intent to publish our report
16 as draft.
17 We would like to describe this morning a
18 little bit of the summary of our methods. Certainly,
19 we intend to use it, and for reference purpose on the
20 third bullet, when we talk about the use as indicated,
21 Chapter 13 of the report summarizes the uses. And when
22 we discussed this with ACRS yesterday, in particular,
23 they noted pages 13-1 and 13-2, which is the same uses
24 that we have been talking to you about for many
25 months.

1 On the last bullet we want to inform you
2 that, as we discussed, following the peer review, we
3 would do -- what we said was prepare a final version.
4 In terms of time, that looks right now that it could
5 be mid- to late-'90. The exact peer review schedule is
6 a little indeterminate, but it could be on the
7 vicinity of, perhaps, nine months, or so. And then it
8 takes time to do what they said. So, that's just a
9 rough projection.
10 CHAIRMAN ZECH: Mid- to late-1990?
11 DR. ROSS: Yes.
12 CHAIRMAN ZECH: When the final report you
13 are projecting could be out?
14 DR. ROSS: Yes, that's correct.
15 CHAIRMAN ZECH: All right, thank you.
16 DR. ROSS: We go to the next slide, (slide),
17 on the present status. Of course you have the report.
18 The report that we gave you was stamped "pre-
19 decisional". We have not released it to the general
20 public.
21 Next Monday and Tuesday we are having a
22 final QA review, looking for arithmetic mistakes and
23 so on. Based on that, we expect to send a report to
24 the printers in May and get a couple thousand copies
25 printed. And my guess is it would be available for

1 distribution in early June. It will be characterized
2 as a second draft for peer review. We will give it the
3 same wide distribution as in '87, and that was well
4 over 1500 copies worldwide.
5 Vic has already discussed the peer review
6 organization. I would note that the ANS special
7 committee which gave us the report on the '87 draft,
8 is alive and well, and they also will review this '89
9 version and issue another report in some time element
10 that is not known to me now.
11 We are going to discuss some of the methods
12 with them next week. They do not have the report of
13 course either. They will get it as soon as it is
14 available to the public.
15 Next slide, (slide). We have done, in the
16 '89 version, something we didn't do in the '87, the
17 external events. And we will discuss the results, in
18 terms of core damage frequency and risk, in a few
19 moments.
20 A little more detail on the seismic
21 analysis, especially in response to Commissioner
22 Rogers. The main point of interest, I think, on the
23 seismic portion of external events has to do with the
24 way we, in effect, shook the site. We have had a
25 research project, funded through Lawrence Livermore

1 Lab, for a number of years that produces what we call
2 seismic hazard curve. Now, seismic hazard curve is
3 just a return interval, or probability per year that a
4 given exitation is available at the plant. You can
5 call it a probability.
6 For example, at the 1-g level that Mr.
7 Stello was talking about, we are looking at return
8 intervals of about a million years, or 10 to the minus
9 six per year.
10 At about the same time, that is over the
11 last few years, the Electric Power Research Institute
12 has also produced hazard curves. And these are hazard
13 curves for about 70 sites, essentially everything east
14 of the Rockie Mountains. And both projects, the EPRI
15 study and the NRC study, we made extensive use of the
16 same type of expert opinion that we are going to talk
17 to you about this morning. And the main thing is
18 this is not an exact science, far from it.
19 The hazard curves that we developed and that
20 EPRI developed, at particularly high earthquake
21 levels, differ quite a bit. And in Appendix C-11 of
22 our report we illustrate graphically, and in some of
23 our slides this morning we will show you that you get
24 factors of 20 difference in core damage frequency.
25 This may not be a question of who is right

1 and who is wrong. Both analysis methods tend to be
2 reasonably robust and in some case, the same people
3 were on both panels, both EPRI and Livermore. It well
4 may be that these represent a range of plausible
5 outcomes. It is something that merits a lot more
6 study -- that's one of the problems.
7 Another problem has to do with I think what
8 I call safety goal philosophy, the quantitative
9 objectives in the safety goal compare nuclear risk as
10 a desirable small fraction of non-nuclear risk. If
11 you look in the vicinity of the site, we have the
12 capability to calculate off-site damages from a
13 nuclear event.
14 As Mr. Stello said, we don't have that
15 capability for non-nuclear events. There have been a
16 lot of recent developments, including a very recent
17 publication from the National Academy entitled
18 Estimating Losses from Future Earthquakes. We got
19 this report about four, or five days ago, it is that
20 recent.
21 A quick glance at it looks like this. And
22 perhaps in consulting relationship with the Geological
23 Survey, we could probably do, or have the Survey do,
24 estimates around these two plants, Surry and Peach
25 Bottom, for non-nuclear seismic earthquake losses.

1 And maybe that's a good idea and maybe it isn't. This
2 is what Mr. Stello is talking about, we've got to do a
3 lot of thinking about it. But we do want to try to
4 put the question of nuclear seismic risk in context
5 with the non-nuclear. That's the thing that will take
6 more work.
7 COMMISSIONER ROGERS: Well, do you expect to
8 resolve the differences between the EPRI and Livermore
9 models before the final report is published?
10 DR. ROSS: Well, as I said, I don't know that
11 we will ever resolve the difference in saying who is
12 right and who is wrong. Since both calculations
13 appear to be reasonably robust, they just may
14 represent a range of outcomes, and we will say
15 somewhere in this range maybe the true response. And
16 we may not try to do anything more than that. That
17 may be the best we can push the science.
18 So, for that reason on the third bullet, we
19 terminated the seismic response in 1150 to what some
20 people refer to as Level 2, which is you do the core
21 damage frequency, the containment response, but you
22 don't do the off-site consequences.
23 We hope -- if you look at the last bullet--
24 we could include all of this in the final version.
25 That may be -- it depends on how these developments

1 work out with Geological Survey and others.

2 Okay, the next slide, (slide), we talk a

3 little bit about the methodology which has changed

4 somewhat, mostly in response to the public comments we

5 got from the '87 version. So, I will talk about the

6 approach, the data base, what we call, or what is

7 generally called Expert Elicitation and how we display

8 the results, which is a major complaint we had from

9 the '87 draft, and then a progress report on the

10 supporting documentation.

11 The next slide, please. (Slide) This next

12 slide is a flow chart. Starting at the top, Accident

13 Frequency, we talked to you about that in March. Then

14 as you run down --

15 CHAIRMAN ZECH: I can't see that slide very

16 well. Does everybody have copies of the slides?

17 (No response)

18 CHAIRMAN ZECH: Could you have done any

19 better for the slide here? It looks to me like it is

20 really kind of useless. As long as we've got copies

21 it is all right.

22 DR. ROSS: We are zooming in on it, I see.

23 CHAIRMAN ZECH: That will help.

24 DR. ROSS: From top to bottom on this chart,

25 we started Accident Frequency, and then you take one

1 step down and you see how the accident progresses and
2 you produce accident loads on the containment and the
3 structural response of the containment. That's called
4 an Accident Progression Bin.
5 And if you move one step down again, you get
6 to the bin called Source Term Groups. And now we are
7 transporting radioactive material around the primary
8 system and the containment. If you march one step--
9 by the way at this point, you could stop and say you
10 had a Level 2. And if you move one step down again,
11 you get the off-site consequence and you worry about
12 things that we call Consequence Measures, early
13 fatalities, latent fatalities, property damage and so
14 on.
15 The whole thing put together then is Risk
16 Integration. That's a very brief snapshot of our
17 methodology.
18 The next slide, please. (Slide) At our
19 March briefing we mentioned developments in
20 phenomenological data base and these eight bullets on
21 here are the same we talked to you about in March.
22 The importance I think, and this is something that I
23 think we are going to have to make clear to the peer
24 review committee, is that as of about March, or April
25 of last year, '88, we, in effect, had to turn the key

1 off on phenomenological improvements as it affected
2 the report and do some calculations.
3 So research development -- and certainly,
4 since we are spending a lot of money, I think wisely,
5 in producing a lot of data -- are still coming in.
6 Technically, the report would be current as of the
7 spring of '88. And as you would expect in any large
8 project, you have to do this. We will have to explain
9 that to the peer committee, make sure that they do
10 understand it.
11 But I don't intend to discuss this any
12 further, since we did cover it in March.
13 COMMISSIONER ROGERS: Do you have any idea
14 of the sensitivity of the results of the report as it
15 stands now to some of these new findings and data?
16 DR. ROSS: Well, no. I think there are two-
17 - in fact, it may well be the last two bullets on this
18 page. So, let me look at the last bullet, test on
19 Mark-1 melt spreading and shell failure. This is one
20 of the areas of highest uncertainty. We've learned
21 nothing since March '88 that would change our mind.
22 The core concrete tests done come along all
23 too often. There are some residual questions there
24 regarding, I think, the overall phenomenon such as
25 heat transfer to an overlying pool. And, again, I

1 don't know of any recent development that would change
2 our mind there.
3 So, no, nothing has happened big to change
4 our mind. A lot of it is going back in -- feeding
5 back in to make the models predict better, but we
6 don't have any new plateau, no.
7 (Slide) On the next page is a -- in fact, I
8 had better look up and see -- this may be another one
9 that may be a bit hard to read from the television
10 monitor.
11 CHAIRMAN ZECH: Yes, it is.
12 DR. ROSS: Okay, let's zoom in on, roughly,
13 the top half of this slide. I would say the single
14 biggest criticism in the '87 draft was in the analysis
15 and display of uncertainty. First, let me talk about
16 the analysis, the changes in the analysis.
17 We went to a relatively mature technique
18 elicitation of expert opinion. It has been done
19 widely in other topics. In fact, it was done in the
20 seismic hazard studies I previously mentioned. We had
21 some consultants and decision analysts that helped us
22 in this. And we went through a chain of things,
23 starting at the front with Selection of Experts. And
24 one of the criticisms that we had last time, that we
25 were to incestuous, if you will, too involved, too

1 much NRC and laboratory people, and we needed to
2 expand our data base and get more experts, outside of
3 this closed community, which we did, including
4 academia and the regulated industry, including
5 Electric Power Research Institute.
6 We had a broader selection of experts. And
7 as we follow the flow path, we selected issues which
8 the panel of experts were free to reject, expand, or
9 modify as they saw fit. We had to train them in the
10 methods of elicitation, so they could convert what we
11 call their substantive knowledge and things into
12 normative knowledge, which means they could put a
13 probability distribution function on their knowledge,
14 and represent it in more or less standard ways.
15 We had processes where they would gather and
16 exchange information, the technical evidence--
17 further on to the right of this chart. From time to
18 time, the experts -- by the way, one of the members of
19 one of the panels is here at the table, Joe Murphy,
20 was on one of the front end panels. They might decide
21 that they weren't expert on that issue and just reject
22 it and just say go find another panel that is an
23 expert. And this did happen at least once, in fact,
24 on the panel that Joe was on.
25 Let's move down to the bottom half of this

1 slide now.

2 COMMISSIONER ROGERS: It is very reassuring

3 to find that kind of courage to make that decision.

4 It is comforting to know that they were open enough to

5 --

6 DR. ROSS: This particular issue is reactor

7 coolant pump seals, and there is not maybe that many

8 people that feel expert about it.

9 The experts would prepare their analysis,

10 and they discuss them with each other. But when they

11 come to the block on the slide marked "Elicitation of

12 Experts", and this is done privately. That is each

13 expert with a decision analyst would give his own--

14 convert it into the ingredients needed for the

15 probability calculation. This private elicitation--

16 by the way, which is documented. Many of these -- we

17 have 24-hours of videotape and the elicitations all on

18 an audio recording. This avoids mob, or group

19 psychology, where the strongest person can kind of

20 bully or dominate the rest.

21 And then when we went together -- no matter

22 how many experts we had, we treat each expert equally

23 and averaged them arithmetically, and produced an

24 aggregate expert opinion.

25 So, that's pretty much the process. It is

1 very time-consuming, it took many months. And in
2 terms of money, it took a lot of money. I think it
3 was worthwhile.
4 COMMISSIONER ROGERS: I understand that some
5 other uses of this technique actually weight the
6 experts, judging each other, in terms of their
7 credibility. That is a weight for --
8 DR. ROSS: Yes, that's correct. And there is
9 a very subtle way to weight it. I have said we
10 average them arithmetically. You can also take the
11 nth root of their product, "n" being however many
12 experts. That's the so-called geometric mean, which
13 is I think a poor use of the term. But what this does
14 is if there are some zeros on some of the tails, one
15 end, or the other, then that tends to squeeze the
16 tails in. And the person with extreme views is, in
17 effect, downgraded. But it is subtle.
18 And, yes, there have been studies where
19 experts were weighted.
20 Now, our contractor, Los Alamos, represented
21 by two people who have been very useful to us, Mary
22 Meyer and Jane Booker, have essentially finished a
23 rather -- fairly thick book. And they are going to
24 publish this. They will put a lot of -- I think it
25 will be of general use to the scientific community,

1 not just nuclear. And they have sections on this
2 topic. They said, by far, the least controversial is
3 to go arithmetic averaging, and that's what we did.
4 We did some sensitivity studies, but we
5 didn't use them.
6 COMMISSIONER ROGERS: Thank you.
7 DR. ROSS: (Slide) On the next page another
8 --I mentioned the display of uncertainties was
9 criticized because we didn't show the true
10 distribution. So, we are going to show distributions
11 in different ways in 1150. We will show the fifth and
12 95th percentile ranges. We will show the mean, the
13 arithmetic average and the median. And if you see the
14 little histogram we have here in the middle of the
15 chart, the median with the lower case "m" is where
16 half the area is above and half the area is below.
17 And of course, if you show a histogram, then
18 automatically the biggest one will be the mode. And if
19 it were half, it would be the symmetric distribution
20 shown on the right, then the mean, the median and the
21 mode would all be the same.
22 Unfortunately, this almost never was the
23 case, we had some bimodal distributions and most of
24 the distributions were quite skewed. Nonetheless, we
25 think we are going to show the information and

1 something will be useful.

2 (Slide) On the next page we have a very

3 large number of backup reports. We can group these--

4 all of these reports, and there's about 20 of them

5 that will be published this fiscal year, in three

6 broad categories: accident frequency analysis, on the

7 left, seven volumes; accident progress and risk, in

8 the center, again, seven volumes, and supporting

9 reports.

10 The frequency analysis and accident

11 progression, and risk analysis will also be labeled

12 "draft", for the same reason that the basic 1150

13 report is labeled "draft". Those will also be

14 available, roughly July, or September is the

15 publication date. And the peer panel will undoubtedly

16 be interested in these reports.

17 CHAIRMAN ZECH: They will be available to

18 them, you will have them for them?

19 DR. ROSS: Yes, that's right.

20 CHAIRMAN ZECH: Very good.

21 COMMISSIONER ROGERS: They won't all be

22 ready by the time the panel starts it work though.

23 DR. ROSS: Not the first meeting, no.

24 COMMISSIONER ROGERS: Fairly soon?

25 CHAIRMAN ZECH: But they will be ready

1 during -- DR. ROSS: That's right.

2 I, as a guess, I suspect we will spend a lot

3 of time at the first meeting in briefings, expanded

4 briefings like we are having. But these reports are,

5 collectively, more than a meter thick. So, I don't

6 know anyone that will ever read them all.

7 (Slide) On the next slide, Perspectives,

8 Mr. Cunningham will start the presentation here.

9 CHAIRMAN ZECH: Thank you very much.

10 You may proceed.

11 MR. CUNNINGHAM: I am going to provide

12 perspectives in four areas this morning. First, I am

13 going to summarize the core damage frequency

14 information from internal events, which was provided

15 to you in the March briefing.

16 In addition, we will talk about, or I will

17 display the core damage frequency from external

18 events, seismic and fire. We will then turn to

19 containment performance in severe accident conditions;

20 source terms and comparisons of our risk calculations

21 with the safety goals.

22 In the next slide, (slide) -- as I said,

23 this information was provided to you in the March

24 briefing. It is estimates of the core damage

25 frequency for our five plants from internal events.

1 As was noted in March, the two BWRs studied, Peach
2 Bottom and Grand Gulf, seem to have somewhat -- appear
3 to have lower core damage frequencies. The Zion plant
4 as shown here, has the relatively higher core damage
5 frequency.
6 As Mr. Murphy said in the March briefing, we
7 have information from the Commonwealth Edison Company
8 on the Zion plant, that they intend to make
9 modifications to their design, such that their core
10 damage frequency would be reduced. Certain
11 dependencies in the plant design would be eliminated.
12 Our rough estimate is that the core damage frequency
13 from Zion would then come down by a factor of two to
14 six, depending on how they specifically implement the
15 modifications.
16 If I could have the next slide, please.
17 (Slide)
18 CHAIRMAN ZECH: Are there any other
19 modifications taking place on any of the other plants,
20 in order to reduce core damage frequency, do you know?
21 MR. CUNNINGHAM: There were modifications
22 that have been made since the draft report in 1987.
23 For example, the Grand Gulf plant is, I believe, at
24 roughly a factor of four in core damage frequency
25 today, based on modifications made in 1988.

1 CHAIRMAN ZECH: How about the Sequoyah and
2 Surry plants, have they made any modifications?
3 MR. CUNNINGHAM: I am not aware -- we are
4 not aware of any modifications on those plants.
5 MR. STELLO: Didn't Sequoyah make a number
6 of changes from the early draft?
7 MR. CUNNINGHAM: Yes, that's right,
8 Sequoyah.
9 MR. STELLO: Weren't they the plant that
10 probably made the most changes in the shortest time?
11 Of course, Peach Bottom has been making changes over a
12 longer period of time.
13 MR. CUNNINGHAM: Yes.
14 MR. STELLO: But changes from the two
15 drafts, I would think Sequoyah would probably be -- I
16 am asking for an opinion -- the one where probably the
17 most changes were made?
18 MR. CUNNINGHAM: Sequoyah and Grand Gulf
19 both made significant changes.
20 CHAIRMAN ZECH: Do these slides reflect the
21 latest changes, or not?
22 MR. CUNNINGHAM: They do, except for the
23 Zion plant.
24 CHAIRMAN ZECH: I see. All right, thank
25 you.

1 MR. CUNNINGHAM: If we could go then to
2 slide 16 (slide). This slide shows the external
3 events core damage frequencies, calculated for the
4 Surry plant. On the left is the internal events
5 estimate for reference; in the middle are the two
6 seismic core damage frequency estimates using the
7 Livermore and the EPRI calculations on seismic hazard;
8 on the right is the calculation of core damage
9 frequency resulting from fires in the plant.
10 As I was indicating, it should be shown that
11 the fire core damage frequency is somewhat lower than
12 the contributions from internal events. The seismic
13 analysis, if you consider median values as displayed,
14 would have lower contributions to the median core
15 damage frequency. The mean values tend to be somewhat
16 higher. This is an artifact of the -- in the hazard
17 curves, the mean values tend to be -- or the
18 probability distributions for the hazard curves are
19 very asymmetrical, they are skewed towards the high
20 end, so the mean tends to be higher in the curves.
21 This translates then into a higher mean core
22 damage frequency relative to the median.
23 The next slide provides the same information
24 for the Peach Bottom plant (slide). At first glance,
25 the fire core damage frequency would seem to be higher

1 than what was seen for Surry, or relatively more
2 important. One thing you have to recognize in this
3 slide is that the internal events, core damage
4 frequency for Peach Bottom, is relatively low,
5 relative to other PRA calculations for other plants,
6 and other BWR Mark I's.
7 Again, you also see the rather broad
8 distributions associated with seismic harzard. The
9 median values for the seismic core damage frequencies
10 are roughly comparable to the internal events; the
11 means, because of the skewed distributions of the
12 hazard curves, tend to be a good bit higher.
13 CHAIRMAN ZECH: In looking at those charts
14 for Surry and Peach Bottom, it would appear that the
15 probability of core melt in those plants is greatest
16 in a seismic event.
17 Do you intend to review and involve yourself
18 in any further actions to possibly make changes in the
19 seismic design requirements?
20 DR. ROSS: Let me comment on that in two
21 ways: we have done a number of studies in the past
22 called the so-called A-45 Studies on decay heat
23 removal in seismic. And when we do those we point out
24 areas of vulnerabilities and, in fact, estimate how
25 much good it would do if you fixed it.

1 And in these two plants, Surry and Peach
2 Bottom, we have done somewhat the same thing. We
3 point out the racks for switch gear, if you tie them
4 down better, weld them down better, they wouldn't turn
5 over and the seismic vulnerability would be less.
6 The policy though from the Commission is
7 when we produce peer review, the individual plant
8 external events portion of IPE. And that is under
9 development and it is probably near the end of the
10 year, I think that's our current schedule. If that
11 goes through as planned, then each plant would do a
12 study like this and identify particular
13 vulnerabilities, and if it meets the formula, fix it.
14 What we have done here is to list the
15 weaknesses --
16 CHAIRMAN ZECH: So it will be examined as
17 part of the IPE program, is that what you are saying?
18 DR. ROSS: That's correct, yes, that's
19 correct.
20 CHAIRMAN ZECH: All right, fine. Thank you.
21 Let's proceed.
22 MR. CUNNINGHAM: If we could turn now to
23 slide 18 (slide). This slide provides comparison of
24 the core damage frequency from internal events for
25 Surry and Peach Bottom in this version of 1150 versus

1 the Reactor Safety Study of 1975.

2 As may be seen, the Surry core damage
3 frequency today is somewhat lower; the Peach Bottom
4 core damage frequency is considerably lower than from
5 1975. There are two reasons for this, one is
6 differences in the way in which we model plants in the
7 PRA process. Perhaps more important though is
8 modifications to the plants that have occurred in the
9 last 15 years.

10 Surry, for example, has made extensive
11 modifications to cross-connect important piping
12 systems and emergency core cooling systems between the
13 two units of the plants. So in some circumstances, if
14 the equipment in one plant fails, they have the
15 ability to go to the other plant, the other unit and
16 provide cooling water, auxillary feedwater, what have
17 you.

18 Peach Bottom also has had a lot of changes
19 in the last 15 years. Perhaps one of the most
20 important is one of the dominant sequences in the
21 reactor safety study, it was a long-term loss of decay
22 heat removal. That accident sequence has essentially
23 disappeared by our analysis today because of
24 modifications to the plant since then. One aspect of
25 those modifications has been the ability to vent the

1 containment in this particular accident sequence that
2 has a significant impact on the core damage frequency.
3 If I could move now to the next slide
4 (slide). This slide provides the frequency of early
5 containment failure for each of the five plants. This
6 is one measure of containment performance, in general,
7 in severe accidents. What can be seen here is, for
8 example, the three PWRs seem to have a comparable
9 absolute frequency of early containment failure. The
10 two BWRs seem to be somewhat lower. This is
11 principally due to the fact that the core damage
12 frequency of the two BWRs is a good bit lower, as we
13 have estimated them.
14 The next slide (slide) provides another
15 measure of containment performance. This is the
16 traditional probability of early containment failure,
17 in effect, given a core melt. So, if you were to have
18 a core melt in these plants, here is a measure of how
19 the containment will perform.
20 On the left is comparison of the reactor
21 safety study values for a particular accident, a
22 station blackout accident at Surry. In 1975 the
23 estimate was on the order of 80 percent of early
24 containment failure with a station blackout accident.
25 Today our estimates are significantly lower, the mean

1 value on the order of a few percent, something like
2 that. This is also quite a distinct difference from
3 the draft NUREG-1150 of two years ago, where we saw
4 that the containment performance was not as good as it
5 appears to be today. There was one particular issue,
6 the issue of direct containment heating, that we
7 understand better today, and believe that it is not as
8 serious a threat to early containment failure as we
9 estimated two years ago.
10 On the right-hand half of the slide is a
11 comparison of the reactor safety study likelihood, or
12 probability of early containment failure in an ATWS
13 event in the Peach Bottom plant, relative to today.
14 It is a little difficult to see, but the Reactor
15 Safety Study, in effect, said that given an ATWS
16 induced core melt, essentially the containment would
17 fail with unity probability and early.
18 Today we see a very broad distribution of
19 that containment failure probability, stretching from
20 a few percernt to essentially 100 percent.
21 This was -- the phenomena that lead to this
22 early containment failure are quite different today
23 relative to 1975. In the Reactor Safety Study their
24 estimate was that the dominant failure mode would be
25 from an over-pressurization of the containment from

1 steam. Today we are seeing a combined effect of some
2 steam over-pressurization failures, also, over-
3 pressurization from the failure of the drywell by
4 direct contact with the molten core as it comes out of
5 the vessel. This is the so-called drywell shell
6 failure mechanism.
7 COMMISSIONER CURTISS: Is this difference
8 between '75 and today explained entirely because of
9 different view about the phenomenon, or is it
10 attributable, in part, to the fixes that have been
11 adopted since then?
12 MR. CUNNINGHAM: It is a combination of
13 both, I think. The way that we analyze an ATWS event
14 today is different, such that we would not see the
15 extent of steam over-pressurization as we did in '75.
16 That is an analysis difference.
17 I suppose, also, the second aspect is more a
18 different understanding of severe accident phenomena
19 today. Also, the drywell shell failure mechanism was
20 not identified in the Reactor Safety Study as a
21 threat. So I guess it is mostly our understanding of
22 severe accident phenomenology that has made the
23 change.
24 I should note that the broad distribution
25 that we see here for the Peach Bottom early

1 containment probability is the result of a rather
2 polarized set of judgments in the technical community
3 on the potential for drywell shell failure by contact
4 with molten material. There are experts that we used
5 who believed that, in effect, it would never occur.
6 There are also an equal number of experts who believed
7 that essentially it would occur with unity
8 probability. Thus, you get a very, very broad
9 distribution. This is a case of a very bimodal
10 distribution that Dr. Ross alluded to a little while
11 ago.
12 The next slide (slide) shows a measure of
13 the plant performance for the Surry plant in terms of
14 the potential for radioactive release fractions, the
15 amount of radioactive release that could occur in an
16 early containment failure in the Surry plant. The
17 comparison is made here with the Reactor Safety Study,
18 the triangles in the figure are the Reactor Safety
19 Study values for a comparable type of accident. The
20 distributions then are shown in the way that we have
21 done it in other areas for the 1150 study.
22 In this particular circumstance, for the
23 early containment failure it appears that the values-
24 - our assessment today is that the source terms are
25 lower than what 1400 would have estimated. The mean

1 values of our present distributions tend to be
2 somewhat lower than the Reactor Safety Study values.
3 The median values are significantly lower than the
4 Reactor Safety Study values.
5 In contrast to this display of radioactive
6 releases for an early containment failure, the next
7 slide (slide) provides an estimate for late
8 containment failure. As can be seen here, the most
9 apparent thing is the late containment failure has a
10 dramatically reduced potential for radioactive release
11 relative to early release, orders of magnitude lower
12 in potential release.
13 The comparison with the Reactor Safety Study
14 is not so clear for this type of containment failure.
15 However, given that this type of release, or this type
16 of containment failure is relatively unimportant to
17 risk relative to the early ones, the differences don't
18 seem to make much difference.
19 COMMISSIONER ROGERS: What was really the
20 reason for the big difference from the earlier study,
21 the Reactor Safety Study, which are the triangles?
22 MR. CUNNINGHAM: Yes.
23 COMMISSIONER ROGERS: All pushed up higher-
24 - why is that?
25 MR. CUNNINGHAM: It is probably mostly the

1 result of our improvements in the understanding of
2 severe accident phenomenology. We took credit, we now
3 have physical models for certain parts of the process
4 that we did not have in 1975. For example, retention
5 of radioactive material in the reactor coolant system
6 was not really considered in the Reactor Safety Study,
7 or it was considered, but it was basically said at the
8 time that we did not have enough information to give
9 it anything, other than to say that everything that is
10 released from the core will be released out of the
11 reactor coolant system.
12 Today, we model the physics and the
13 chemistry of those events that can have an effect on
14 these releases. I think, in addition, there is just a
15 general improvement in our understanding of
16 containment and containment source term analysis.
17 MR. STELLO: Commissioner Rogers, I would
18 just simply say that the short answer is we have 15-
19 years of research that we have put into this area that
20 we are now using to provide that.
21 COMMISSIONER ROGERS: Is this one of the few
22 cases, or are there others where the later study
23 begins to show a little less favorable results than
24 the earlier study, in terms of release fractions?
25 MR. CUNNINGHAM: I'm sorry, I didn't

1 understand.

2 COMMISSIONER ROGERS: Looking at Slide 22,

3 things get worse?

4 MR. CUNNINGHAM: Things get worse for very

5 small releases. It could be that you are in a regime

6 here, the release fractions are so small that this may

7 be, in effect, almost all noise. There is no --

8 COMMISSIONER ROGERS: I see.

9 MR. CUNNINGHAM: -- discernible difference.

10 There is no real difference between the safety study

11 and the present calculations at this level. These are

12 very small --

13 COMMISSIONER ROGERS: That's a helpful way

14 to put that in some perspective.

15 MR. CUNNINGHAM: Slide 23 provides a similar

16 type of display of early containment failure in the

17 Peach Bottom plant. In this case there are two sets

18 of triangles indicating that our way of analyzing the

19 plant now is not directly correlatable to a specific

20 release category in WASH-1400, so we kind of display

21 two that appear to be the closest. This has more of

22 the characteristic of the slide for early containment

23 failure for Surry, the triangles tend to be between

24 the mean and the 95th percentile on our present

25 calculations. The median values tend to be a good bit

1 less.

2 COMMISSIONER ROGERS: Do these later studies

3 include direct containment heating?

4 MR. CUNNINGHAM: Yes, they do, yes.

5 Turning to Slide 24 (slide), Slides 24

6 through 29 provide estimates of overall risk of the

7 five plants relative to the safety goals and to a

8 proposed probability of large release.

9 Slide 24 compares --

10 MR. STELLO: Excuse me, let me -- I was

11 trying to find a way to characterize -- an easy way to

12 characterize what this number means. And I think the

13 total of all accidents, the probability of someone in

14 the United States, as I recall, being a fatality is

15 about like one chance in 2,000. The average in the

16 United States for all accidents: automobiles,

17 earthquakes, lightning, whatever, per year.

18 So you are looking at where this ranks in

19 terms of getting a fatality. The risk that we take

20 from all sources of all accidents -- I think, if my

21 memory serves me, is about one in 2,000, Bill?

22 DR. ROSS: Yes, 2,000 is right.

23 MR. STELLO: Okay.

24 MR. CUNNINGHAM: As can be seen from this

25 slide, the first slide, Slide 24 is a measure of the

1 average individual early fatality risk for each of
2 these plants compared with the safety goals, that
3 specific safety goal. It can be seen the five plants
4 we've studied are well beneath the safety goals. The
5 two BWRs tend to be signficantly lower than the three
6 PWRs. That is a combination of the lower core damage
7 frequencies and the fact that these particular plants
8 have somewhat lower population distributions about
9 them.
10 Slide 25 (slide) is a comparison with this
11 same safety goal for the two fire risk calculations
12 that we performed for the Surry and Peach Bottom
13 plants. When we are using this specific initiating
14 event, the risks are well below the safety goal.
15 Slide 26 (slide) compares the five plants
16 with the individual latent cancer fatality safety
17 goal. These are well, well lower, much lower than the
18 safety goals.
19 Slide 27 (slide) is the same type of thing
20 for the fire external event, very low compared with
21 the safety goals.
22 Slide 28 (slide) provides comparison of the
23 five plant risks with one specific definition of a
24 probability of a large release. The release is, in
25 effect, the probability of having one, or more early

1 fatalities as a result of accidents at the plant.

2 What can be seen here is in the two BWRs,

3 they are a good bit lower. I should also note that

4 the Zion plant would be expected to come down, because

5 of the modifications that they are making in the

6 design as we speak.

7 COMMISSIONER ROGERS: On the other hand,

8 Surry and Sequoyah are just added, or even a little

9 bit higher probability.

10 MR. CUNNINGHAM: That's correct. The

11 Sequoyah plant -- it tends to be somewhat higher

12 because of the combination of -- Sequoyah is kind of

13 the moderate plant, if you will, it is a moderate

14 relative -- among the five, it has a moderate core

15 damage frequency, not high, not low, moderate

16 containment performance and moderate site, in terms of

17 population. The three of them together tends to keep

18 it somewhat higher than the others.

19 COMMISSIONER ROBERTS: How do you compare

20 Slide 24 and Slide 28? And doesn't Slide 28 give

21 credence to what the ACRS says that you use in a

22 definition of a large release that is a level 10 times

23 more conservative?

24 MR. CUNNINGHAM: That's exactly correct.

25 MR. STELLO: They think we're too

1 conservative in what you were using for a suggested
2 proposed large release, and I think at the meeting
3 with the Commission they made a point rather clear,
4 they think we've gone too far.
5 COMMISSIONER ROBERTS: Well, do you agree
6 with them?
7 MR. STELLO: This is the subject of much
8 debate for many years. I would like to find a way to
9 come to grips with this. I tend to want to be a
10 little bit more conservative, so I lean that way.
11 DR. ROSS: It is also true that their advice
12 and their hierarchy -- would a lower hierarchy, such
13 as the probability of a large release -- shouldn't
14 dominate something like Slide 24. So I think it is
15 the same point. But this is a measure that we used in
16 '87, and for consistency, I think it would be useful
17 to compare '87 versus '89. The distributions are
18 lower than they were in '87.
19 COMMISSIONER ROBERTS: Okay.
20 MR. CUNNINGHAM: The final slide (slide) --
21 COMMISSIONER ROGERS: Just on that, because
22 this is an important point, this large release thing.
23 In defining a large release is it the same -- do you
24 have a standard set of meteorological and geological,
25 or geographic factors that are not plant-specific for

1 that, or are they plant-specific in doing a large
2 release -- in doing this calculation?
3 MR. CUNNINGHAM: For the large release
4 calculation and all of our calculations we use plant-
5 specific.
6 COMMISSIONER ROGERS: Entirely, including
7 the meteorology, local meteorology --
8 MR. CUNNINGHAM: The geography, the
9 population distributions were all plant-specific.
10 COMMISSIONER ROGERS: Everything is plant-
11 specific?
12 MR. CUNNINGHAM: Everything is plant-
13 specific.
14 MR. STELLO: You really can't do the
15 calculation unless you are using plant-specific. In
16 some cases...
17 MR. CUNNINGHAM: The final slide of this
18 package, Slide 29 (slide), is simply a comparison of
19 the fire risk calculation compared with this same
20 probability of the large release definition.
21 If there are no other questions --
22 DR. ROSS: In summary, I think there are
23 four points, (slide). After our QA next week, we
24 expect to clean up the report and be ready to issue it
25 in early June. We hope the peer review can start in

1 July. As I said, it could go onwards of a year.
2 And then sometime after that, to fix the report.
3 And in the interim, we would expect to use
4 the report as per the guidance we got from the
5 Commission. And then eventually, we will, as the peer
6 review is complete, we will modify it and reissue it
7 as a final report.
8 That's our summary.
9 We are available for questions.
10 CHAIRMAN ZECH: All right. Thank you very
11 much.
12 Thank you.
13 Questions, my fellow commissioners,
14 Commission Roberts?
15 COMMISSIONER ROBERTS: I have no questions.
16 This is a tremendous project, I wish you success.
17 CHAIRMAN ZECH: Commissioner Rogers?
18 COMMISSIONER ROGERS: Well, I will just take
19 questions at the moment because I would like to
20 compliment you,too, I will do that separately.
21 The Reactor Safety Study was criticized for
22 the way it handled severe accidents source term
23 calculations, and not being able to follow those, that
24 the reader had a great deal of trouble replicating how
25 that was done. Now, do you see this report in its

1 final form, including appendices, or whatever else,
2 supplementary documents, as really being able to
3 provide a transparency to exactly how all of the
4 calculations were done?
5 Will it be possible to read this report with
6 understanding of the details of how the results came
7 about?
8 MR. MURPHY: Well, that's our goal at least.
9 We have a complex problem, so it is difficult to
10 explain it. I think we will have a -- well, we will
11 have an appendix in the NUREG-1150 itself. So we will
12 try to walk through one problem, so you can see how
13 things were calculated.
14 The details in the contractor reports, I
15 think will be sufficient for somebody -- an expert in
16 the field, who wants to replicate the work. So you
17 have enough information to go forward.
18 COMMISSIONER ROGERS: I don't think it
19 should be a tutorial, but it should be possible for an
20 expert to do it.
21 MR. MURPHY: I think an expert will be able
22 to do it. It will be difficult for a man in the
23 street to get through all of the details.
24 MR. STELLO: I would answer Commissioner
25 Rogers, what I have seen thus far, I don't believe at

1 this time anyone can say that there will inadequate
2 documentation. However, the complexity of the issue,
3 of what we are trying to calculate is going to make it
4 a real challenge to have that information displayed in
5 such a way where we are going to satisfy everyone.
6 I do hope -- we are trying very hard not to
7 have that kind of criticism. But it is going to be
8 very, very difficult because of the massive amount,
9 15-years of very complex research that is, in fact,
10 embodied within this study.
11 COMMISSIONER ROGERS: Well, I think it is
12 terribly important that an expert, not the man on the
13 street, but an expert, be able to go through it,
14 because as Dr. Ross said, this tremendous amount of
15 material says that it is very daunting to someone to
16 try to go through the whole thing.
17 Well, that is something one worries about,
18 because if it isn't possible for an individual to go
19 through it, you know, a hearty soul, who is willing to
20 take the time and effort to do it, one worries that in
21 the hand-off from one part of it to another, to
22 another person, that somehow that total integrated
23 evaluation and confidence that it all hangs together
24 has just got a question mark over it.
25 And I think that it is important that at

1 least recognized experts can go through the whole
2 thing, if they so choose to do so.
3 MR. STELLO: That was one of the early
4 comments that we have worked very hard to fix up. I
5 am confident that we have made a lot of progress. I
6 believe that we will succeed.
7 MR. BECKJORD: I can add a bit to that,
8 Commissioner Rogers. I used, or attempted to use 1400
9 to teach a graduate course in PRA and it was extremely
10 difficult. I really finally went to other sources. I
11 have looked through several cases here, and I think it
12 is far clearer and will be much easier to trace.
13 I don't know that it will reach the
14 conceivable limit, but I think for recognizing what it
15 is doing, I think it has done a better job in that
16 respect, a much better job.
17 COMMISSIONER ROGERS: On this question of
18 using it, I don't know if it is premature to ask the
19 question, but it seems to me that you should have in
20 mind how it could be used in connection with IPEs, and
21 what the relationship between this effort, which is a
22 research effort, should have, will have with NRR
23 activities. And it seems to me that we must make sure
24 that there is a good connect there, so that whatever
25 insights and helpful results have come out of this

1 1150 work are fully available, transportable into the
2 NRR work of the agency. And I think that is very
3 important that that take place.
4 And I know there is some concern about that,
5 but whether it has gone as far as it should --
6 MR. STELLO: The ACRS has clearly suggested
7 we ought to even go further than we have suggested
8 going in that regard, I think. At least Hal Lewis
9 left me with that impression in briefing the
10 Commission, he thinks -- he may be right, but we are
11 being a little bit cautious, and I think it might be
12 warranted to have a little caution.
13 COMMISSIONER ROGERS: Well, as to just, you
14 know, the detailed way in which it is applied. But it
15 seems to me the understanding of it should be
16 something -- MR. STELLO: There is no doubt
17 that everyone that will read 1150 will, in fact, be
18 moved in a way that will -- it will provide those
19 kinds of views and insights, I am convinced. In that
20 context, yes.
21 COMMISSIONER ROGERS: Good, good.
22 Well, I would just like to add my praise to
23 those of Commissioner Roberts, also. This has been a
24 momumental effort. A great deal of courage to embark
25 on it, in the first place. I am sure that you've

1 taken a lot of criticism because something new does
2 properly become criticized. But the perseverance ....
3 displayed in pursuing this, and I am sure it is
4 something that at time may not have looked like it was
5 ever going to come to a satisfactory closure, is
6 really more than commendable. And I would certainly
7 like to say that it really is a great piece of work,
8 even though it may not be perfect, because nothing
9 ever is.
10 MR. BECKJORD: If I could add just one point
11 to your question about the insights. There has been
12 some work done on that, a fair amount actually, there
13 is more to come. And now that the work is done, I
14 think we can concentrate on it. We are giving a
15 presentation at the next Senior Management Meeting on
16 Insights of PRA from 1150, and that's coming up the
17 week after next. And NRR is very interested in that.
18 COMMISSIONER ROGERS: I hope they have a
19 good turnout.
20 CHAIRMAN ZECH: Commissioner Curtiss?
21 COMMISSIONER CURTISS: I don't have any
22 questions. Thank you.
23 CHAIRMAN ZECH: Well, I believe the staff
24 has accomplished a major milestone in improving NUREG-
25 1150 and addressing the comments that you have

1 received. I commend the staff for this effort. I
2 think it is a very, very significant undertaking.
3 And as far as I know, we are the only
4 country in the world that has really taken the
5 initiative in this regard anyway. I know other
6 countries are very interested in what we do, but it is
7 an undertaking that, in my view, has a real
8 contribution to more solid understanding of severe
9 accidents and making a contribution to the safety of
10 reactor operations. There is just no question about
11 it, in my view. And I think it is a very, very
12 commendable undertaking.
13 I, too, congratulate the staff and all of
14 those from Sandia and others who have contributed so
15 significantly to your efforts. I know it has been a
16 contribution of a lot of people. I commend all who
17 are involved in this very significant and very
18 important undertaking.
19 You've told us that you are in the process
20 of conducting a final quality assurance review of the
21 document, and you plan to issue the report as a second
22 draft for peer review in June. The Commission will be
23 requested to formally appoint the individuals that
24 will make up the peer review group in the near future.

1 We recognize, Mr. Stello, that you are still
2 working on this. You've indicated that you believe
3 the peer review group will take approximately 12-
4 months, maybe a little less, but approximately 12-
5 months, or perhaps less. And unless you have major
6 deficiencies identified by the group, that the final
7 version of NUREG-1150 could be expected to be
8 completed sometime towards the end of 1990.
9 The second draft of NUREG-1150 represents a
10 significant effort and I believe the NRC's best
11 understanding to-date on severe accident progression.
12 Therefore, I continue to believe that the staff should
13 be allowed to use the report while it is undergoing
14 peer review, and recognizing that the final version of
15 NUREG-1150 might require some modifications. I
16 believe it would be useful to the industry to have the
17 document and be able to use it for consideration and
18 comment, while the peer review is ongoing. Those are
19 my personal views, however, this is a matter that we
20 have asked the ACRS staff to provide their views on.
21 So we will take into consideration whatever
22 information we receive from the ACRS. And, hopefully,
23 as Mr. Stello pointed out earlier, we will receive
24 that information, perhaps as early as next week. And
25 we will act on it promptly to get back to the staff,

1 so that you can expect that we will, the Commission,
2 will provide you our views and our position on whether
3 you can proceed with interim use by the licensees and
4 others when we receive the ACRS views.
5 So you can expect to receive our final
6 position on that then and I want the SRM to so note
7 that we have made that decision here at this meeting.
8 But I would just like to conclude by
9 thanking the staff, not only for an excellent
10 briefing, but a tremendous amount of work since the
11 original WASH-14 study and attempting to update that.
12 It is a very commendable undertaking and a real
13 contribution, I think, to understanding, as well as to
14 safety of nuclear power operations. It certainly is
15 something that I am very proud to have been a small
16 part of during my time here on the Commission. And I
17 commend the staff for a very courageous and important
18 undertaking that I do believe can make a significant
19 contribution to future operations at nuclear reactors,
20 not only in our country, but around the world.
21 Are there any other comments from my
22 colleagues?
23 (No response)
24 CHAIRMAN ZECH: Thank you very much for an
25 excellent briefing.

1 We stand adjourned.

2 (Whereupon, at 11:23 a.m., the meeting was

3 adjourned)

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CERTIFICATE OF TRANSCRIBER

This is to certify that the attached events of a meeting of the United States Nuclear Regulatory Commission entitled:

TITLE OF MEETING: BRIEFING ON STATUS OF SECOND DRAFT OF NEUREG-1150

PLACE OF MEETING: ROCKVILLE, MARYLAND

DATE OF MEETING: MAY 5, 1989

were transcribed by me. I further certify that said transcription is accurate and complete, to the best of my ability, and that the transcript is a true and accurate record of the foregoing events.

Barbara Rector

Reporter's name: MILES ANDERSON

Commission Briefing on NUREG-1150

Office of Nuclear Regulatory Research

May 3, 1989

Elements of Presentation

- Purpose
- Present Status
- Risk Analysis Methods
- Perspectives
- Summary

Purpose of Presentation

- To inform the Commission of staff's intent to publish NUREG-1150 as second draft for peer review.
- To provide a summary of methods used and results obtained.
- To inform the Commission that the present version of NUREG-1150 will be used as indicated in Commission guidance in February 9, 1989 memorandum.
- To inform the Commission that following peer review, staff will prepare a final version of NUREG-1150 and submit to Commission.

Present Status

- Report assembled and delivered to Commission
- Final QA review on May 8-9
- Plan to send to printers in May, issue in June
- To be published as second draft for peer review
- Same wide distribution as February 1987 draft

- Peer review organization proceding smoothly
  first technical meeting week of July 10
- ANS special committee to be briefed in May

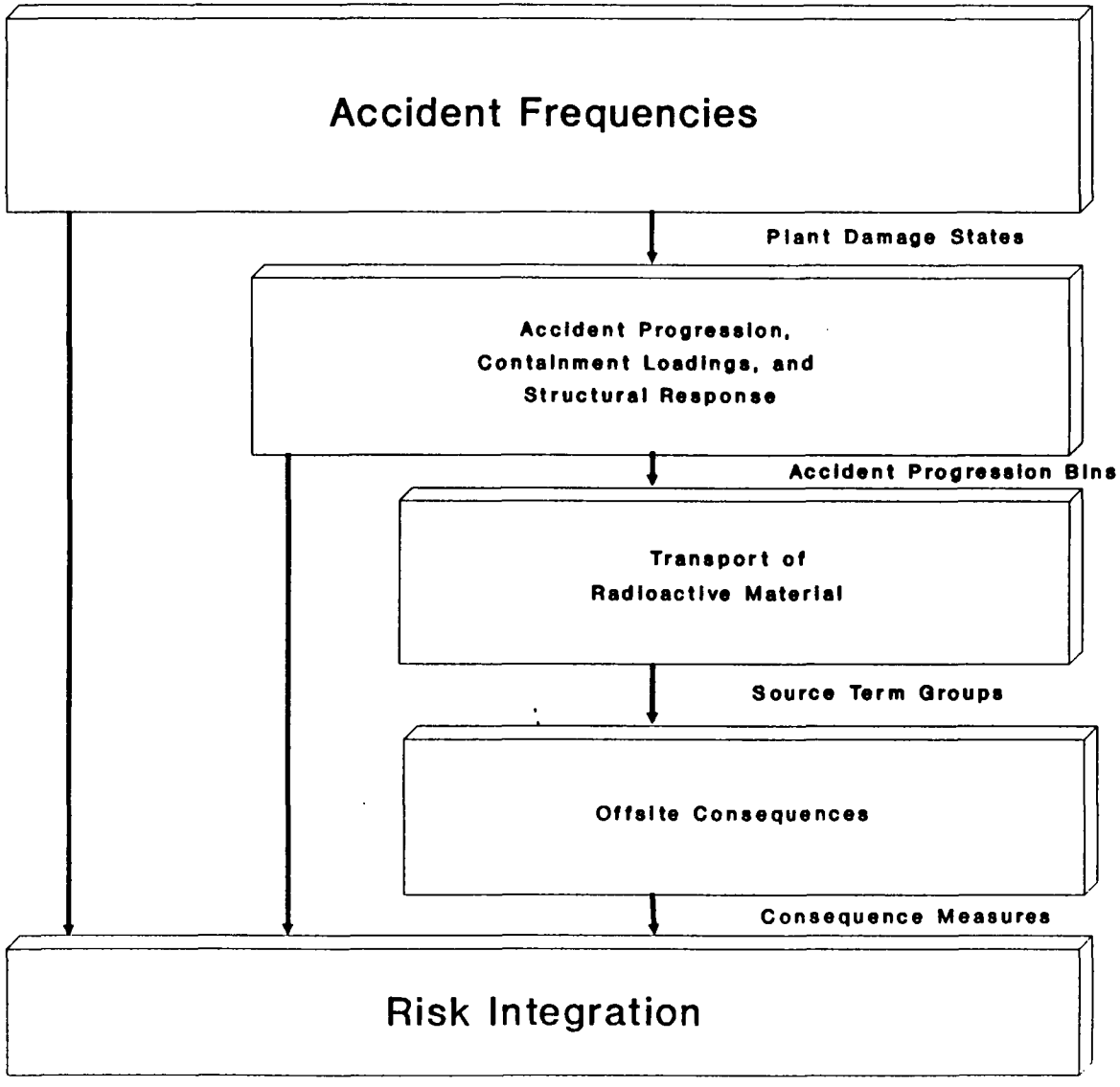
Present Status (continued)

- NUREG-1150 has performed external events analysis on 2 plants: Surry and Peach Bottom.
- Seismic analysis includes consideration of low probability, high intensity earthquakes which could have significant consequences in surrounding population.
- Pending further review, seismic analysis in NUREG-1150 will be limited to core damage frequency and containment performance.
- To aid review of work, contractor documents will include sensitivity studies on seismic risk.
- Final version of NUREG-1150 should include results of seismic risk analyses.

Risk Analysis Methods

- Overall Approach
- Phenomenological Data Base
- Expert Elicitation Process
- Display of Results
- Supporting Documentation

Elements of NUREG-1150 Risk Analysis Process

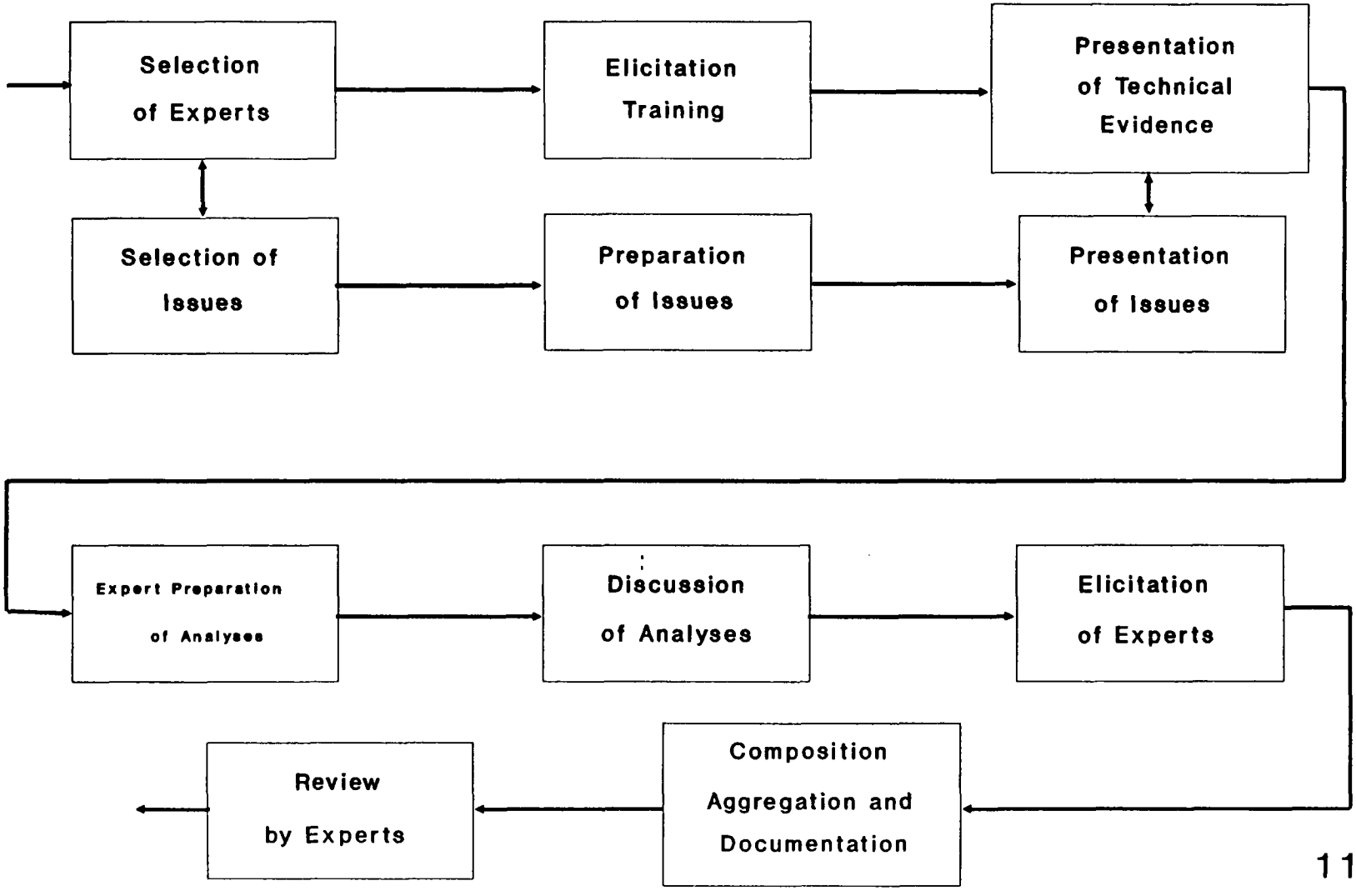


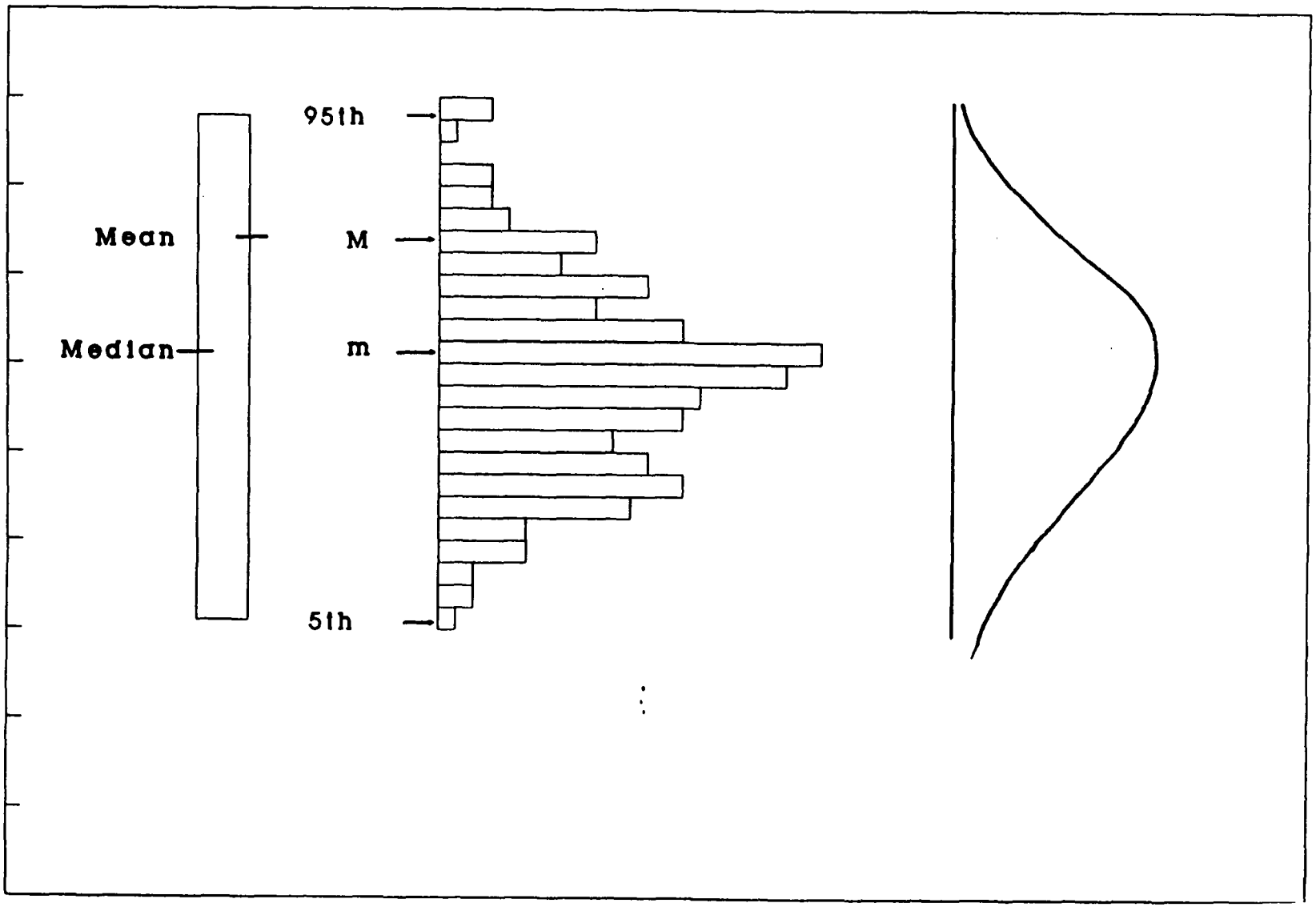
Phenomenological Data Base

Since the completion of draft NUREG-1150, new research information available includes:

- In-vessel melt progression analyses (TRAC/MELPROG, RELAP/SCDAP, MELCOR, BWRSAR)
- BWR severe fuel damage test in ACRR
- Full-length coolant boildown tests in NRU
- Hydrogen DDT and high temperature detonation limits
- Direct containment heating tests in SURTSEY
- Small-scale cavity dispersal tests
- Core-concrete tests with sustained heating
- Tests on BWR Mark-I melt spreading and shell failure

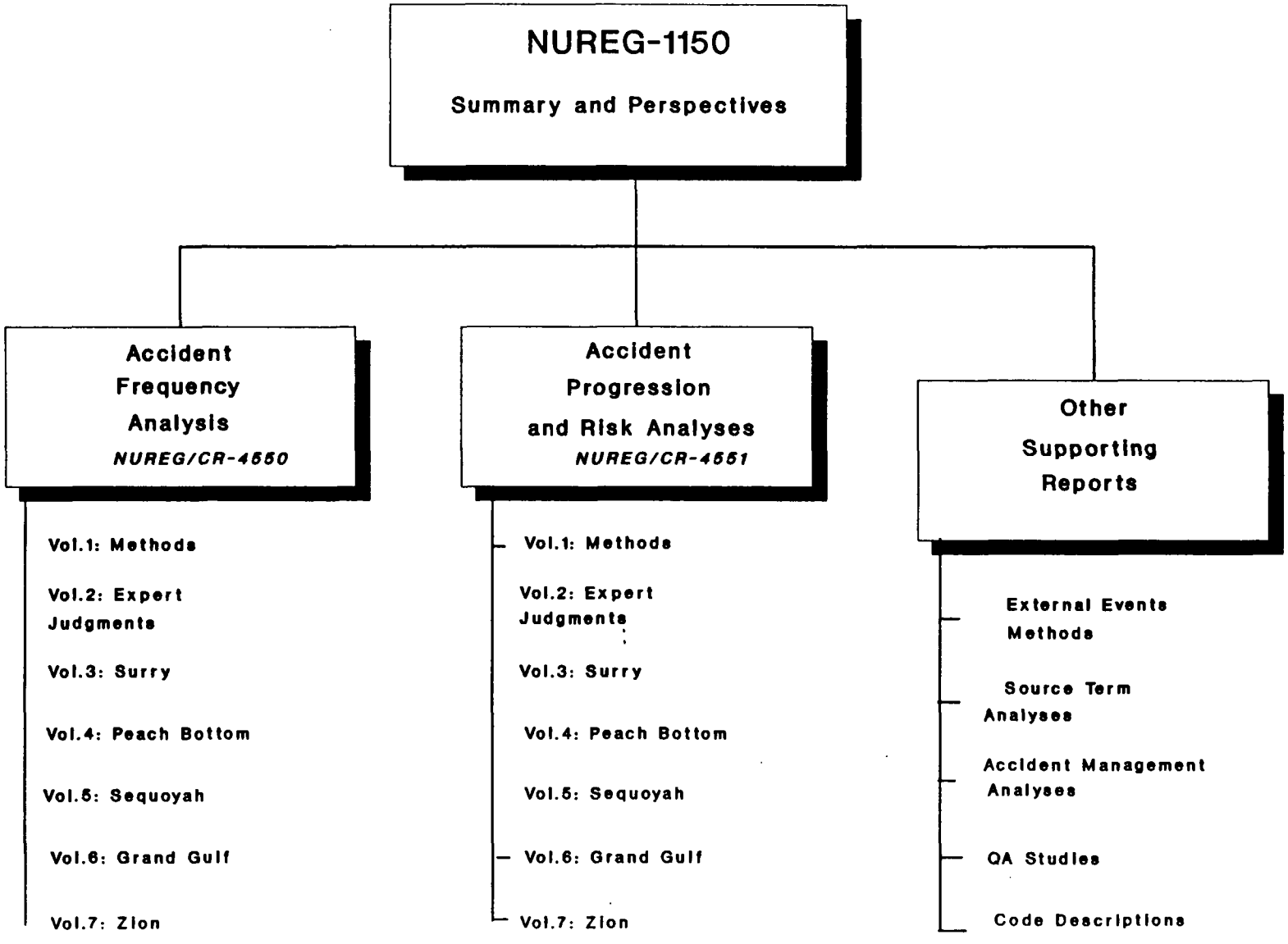
Steps in NUREG-1150 Expert Elicitation Process





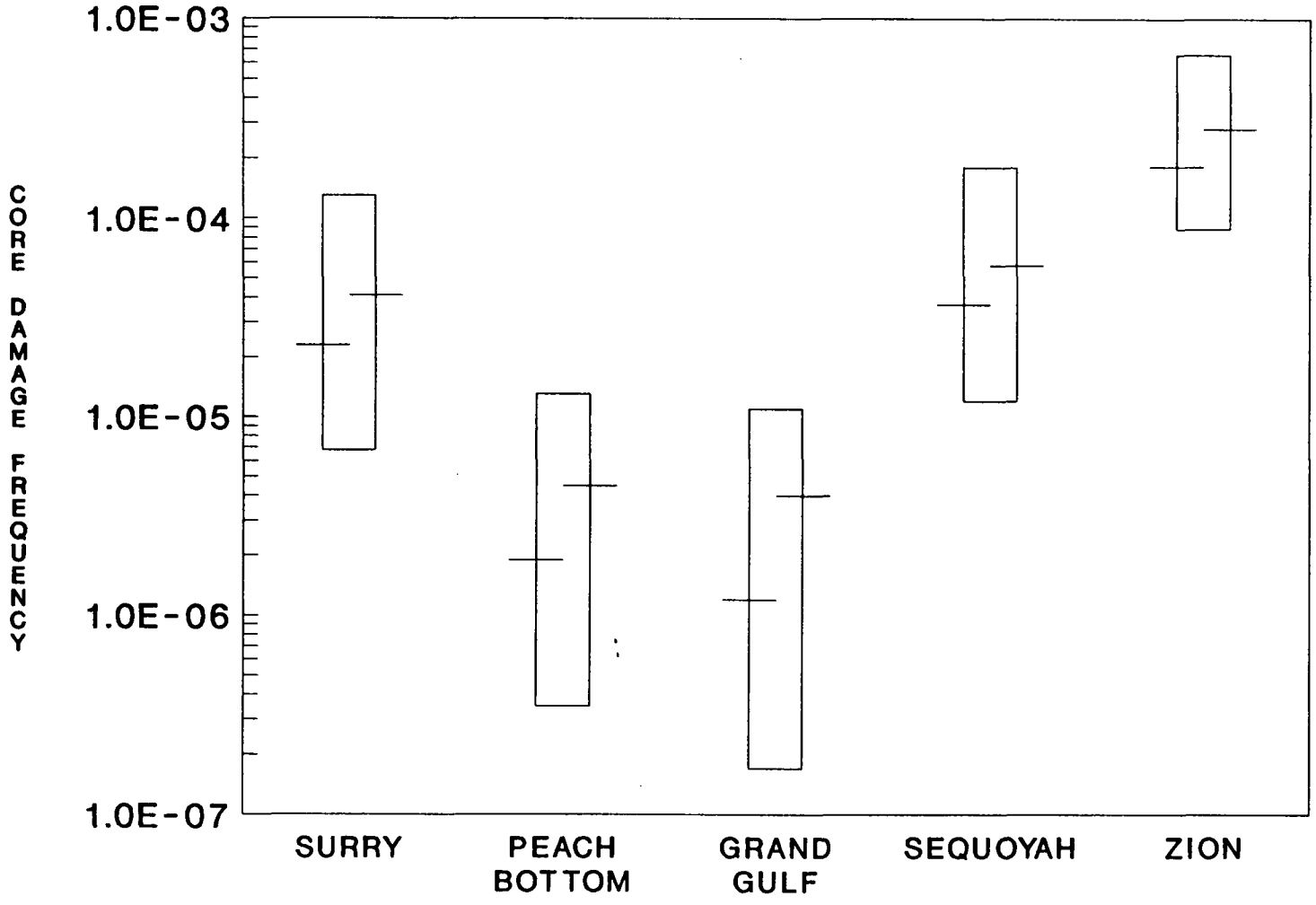
Example Display of Probability Distribution

Reports Supporting NUREG-1150

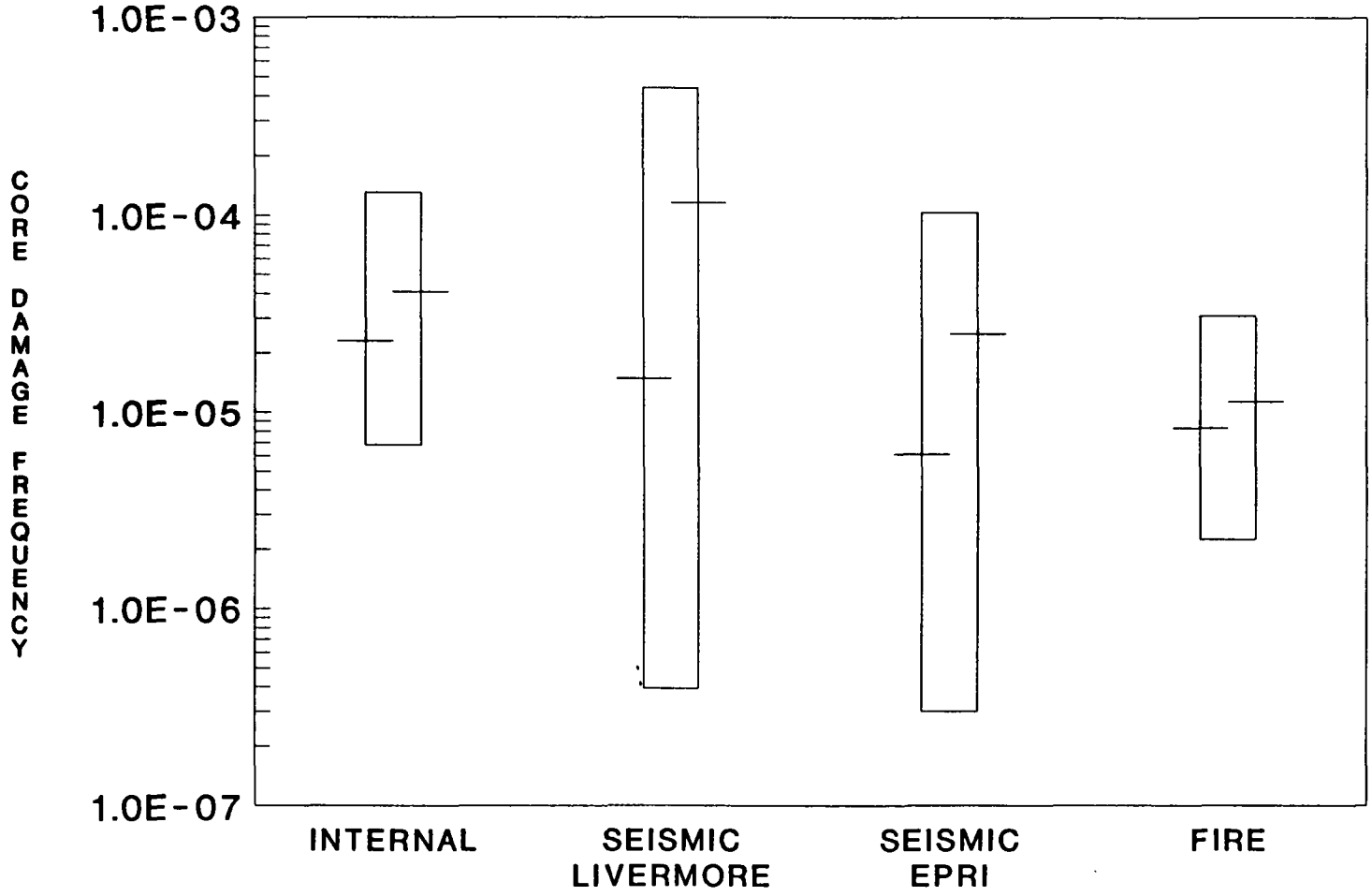


Perspectives

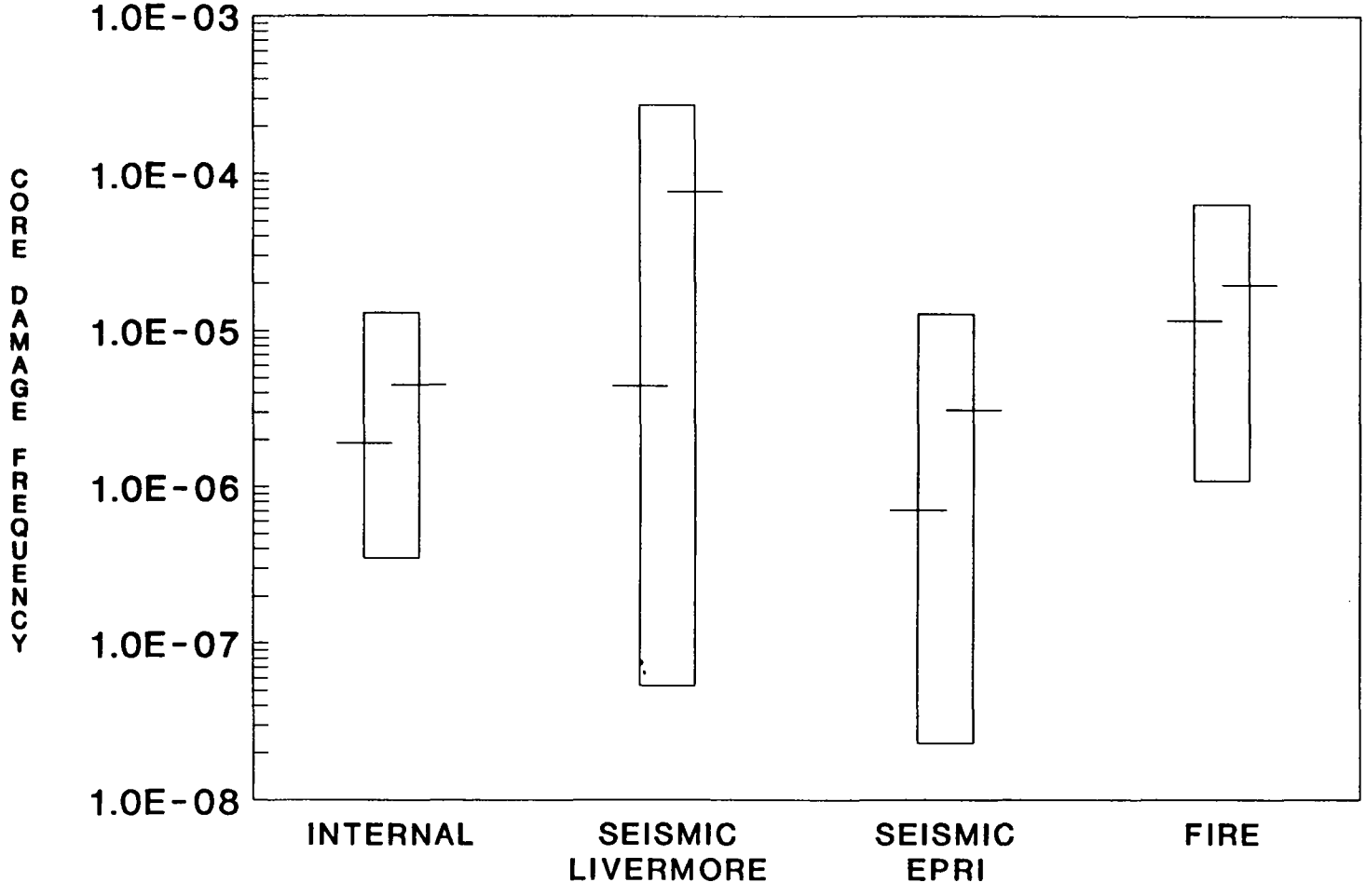
- Core Damage Frequency
- Containment Performance
- Source Terms
- Risk
- Safety Goal Comparisons



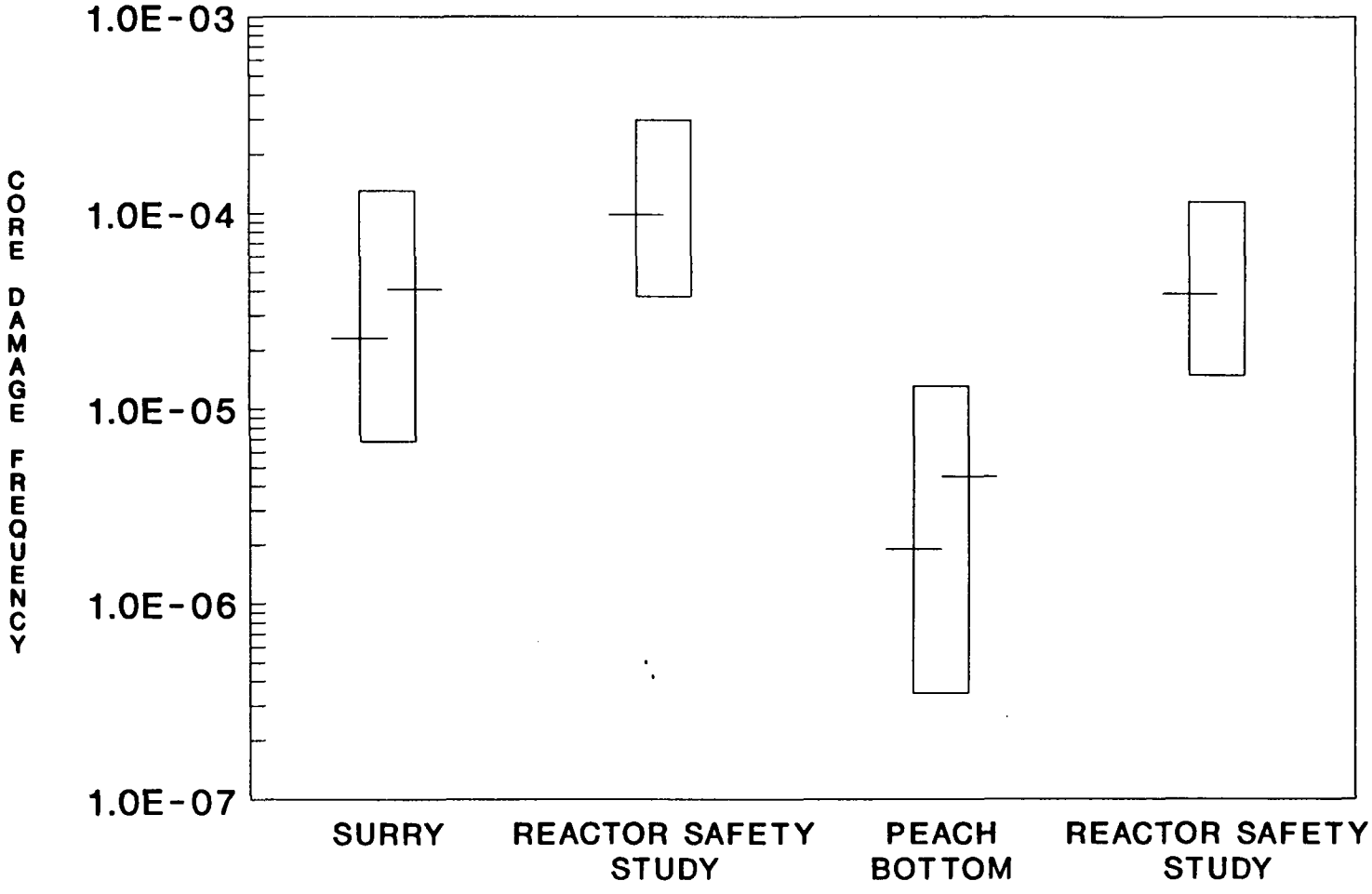
Internal core damage frequency ranges



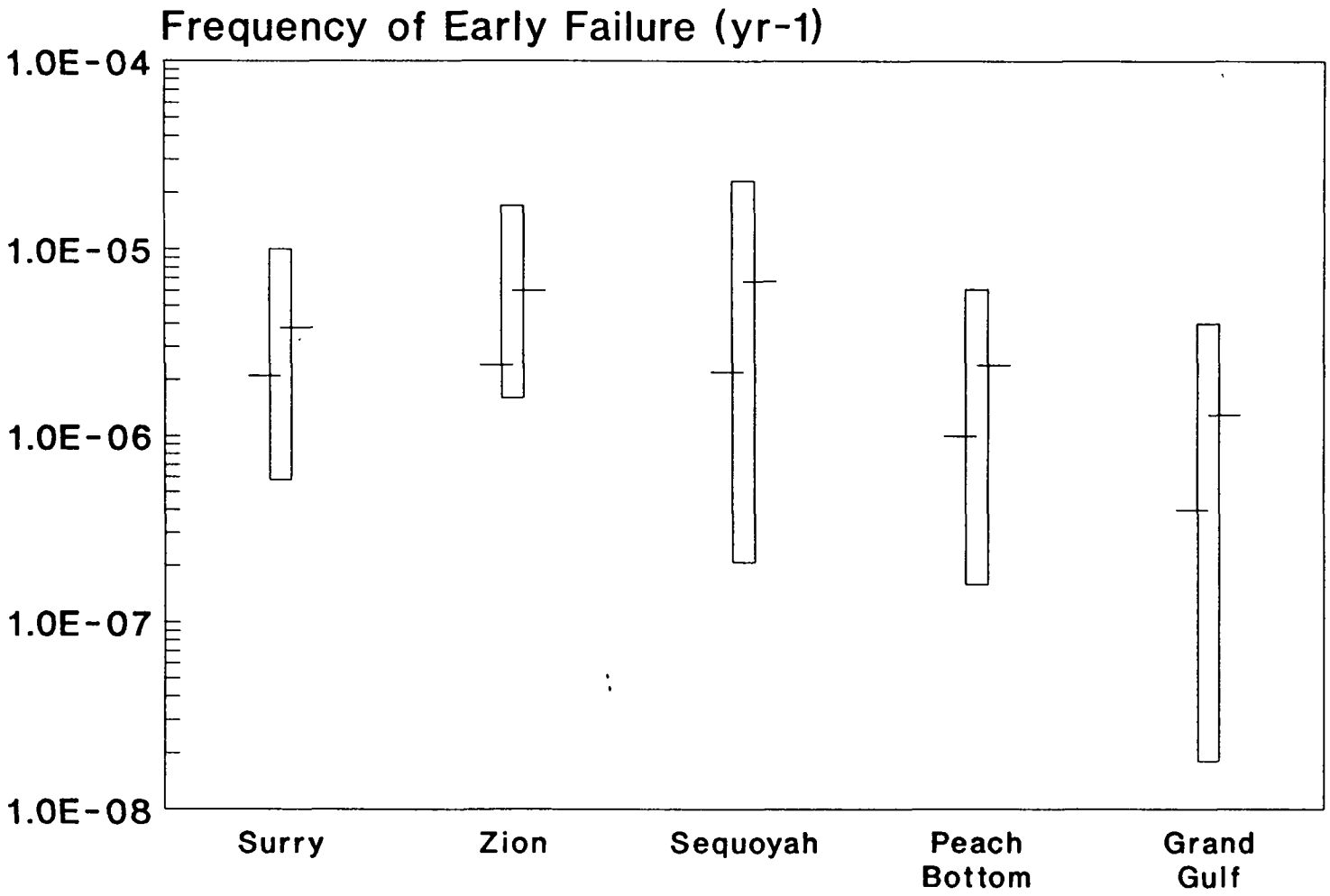
Surry external events core damage frequency ranges



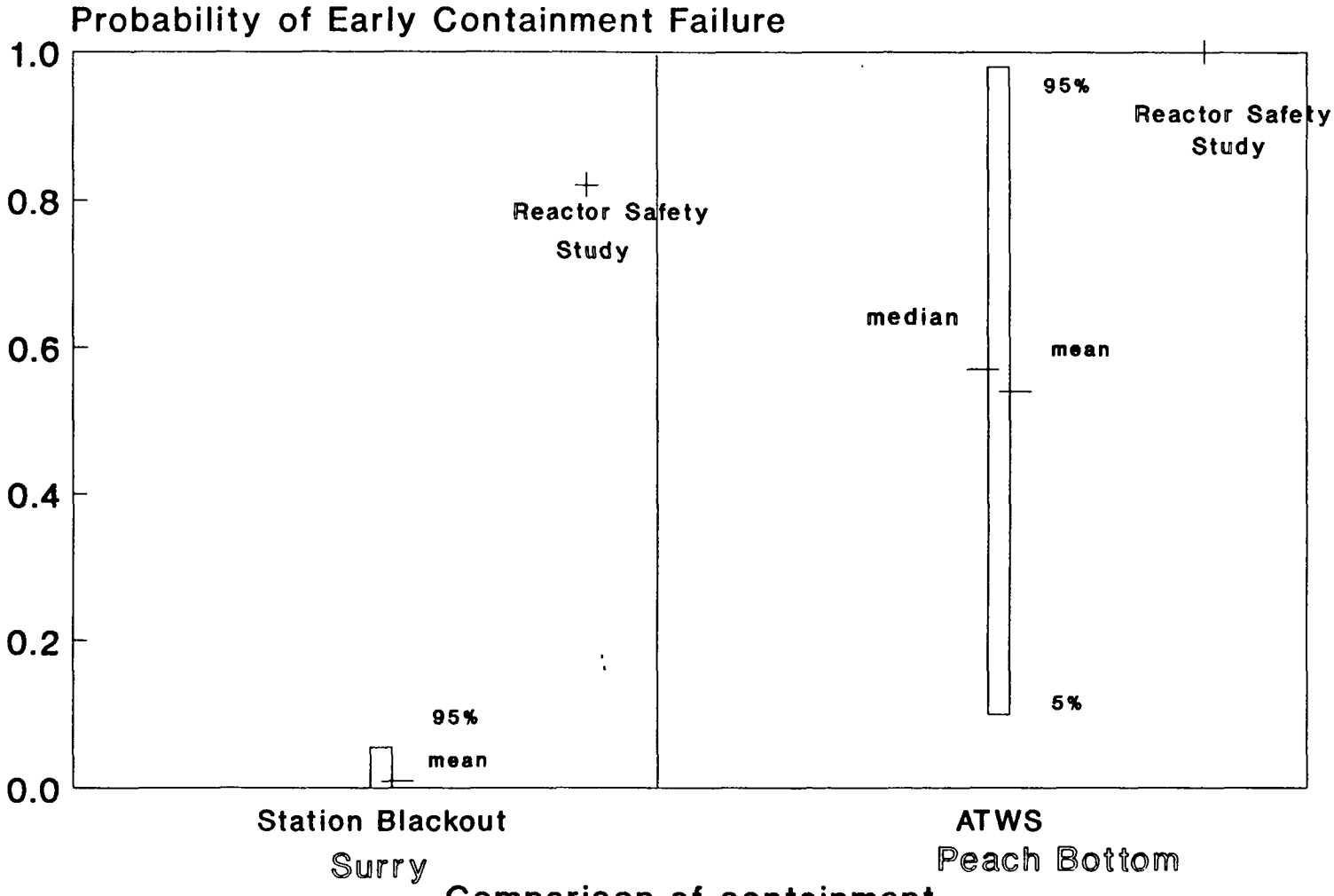
Peach Bottom external events core damage frequency ranges



Core damage frequency ranges
compared to Reactor Safety Study

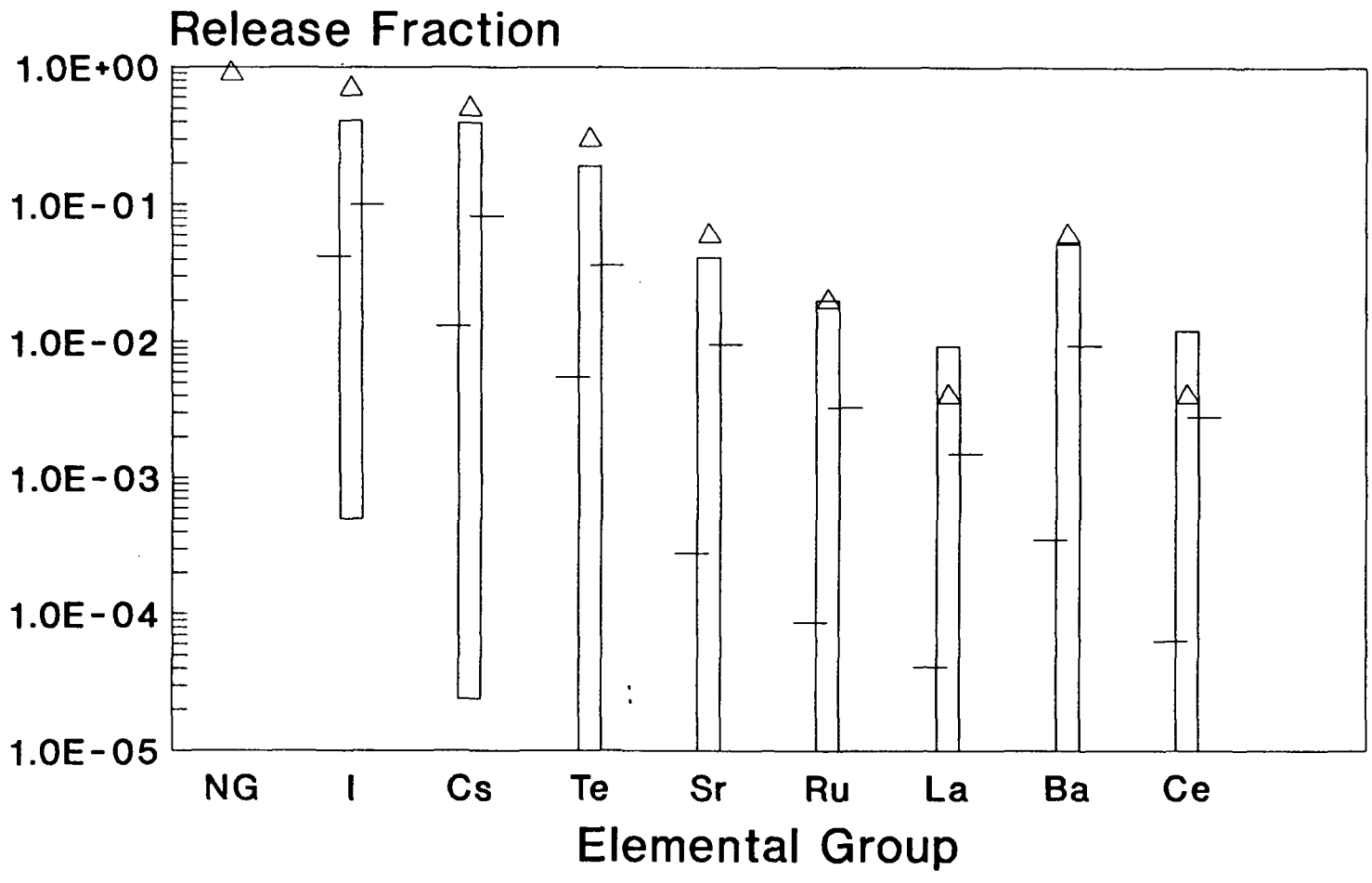


Frequency of early containment failure or bypass



Comparison of containment performance results with Reactor Safety Study

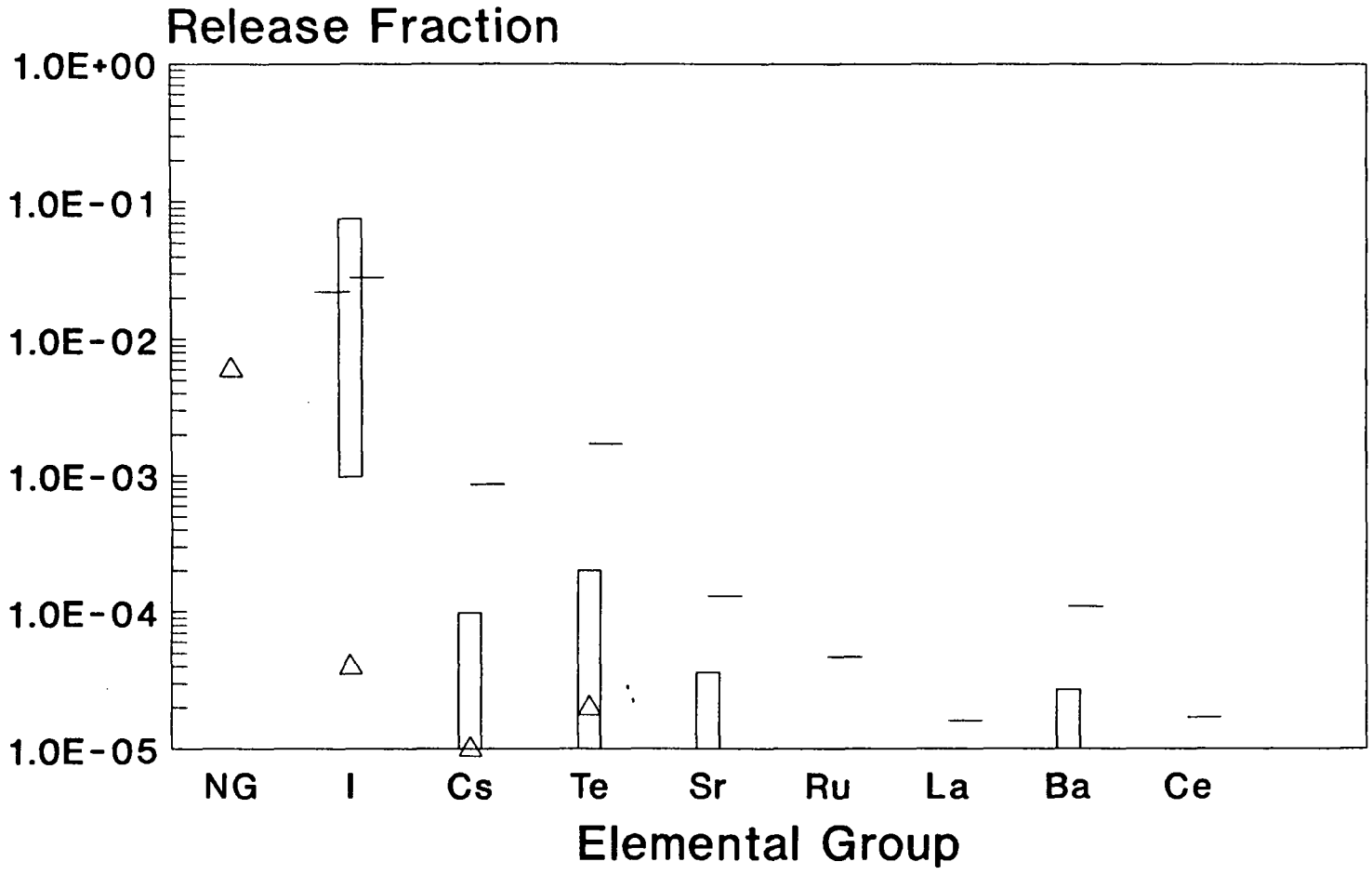
Early Containment Failure



Comparison with Bin PWR2

Comparison of source terms with Reactor Safety Study, Surry

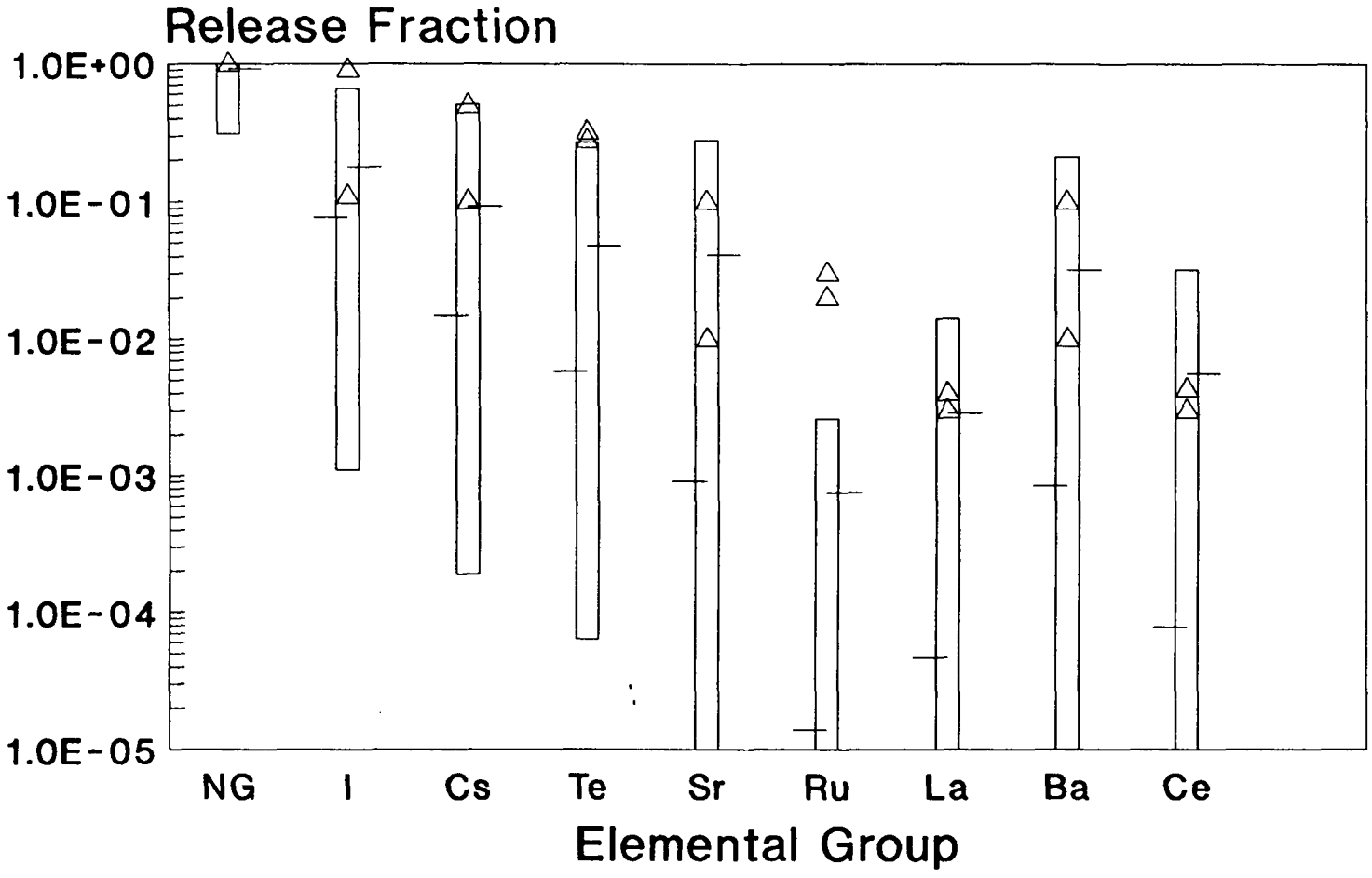
Late Containment Failure



Comparison with Bin PWR7

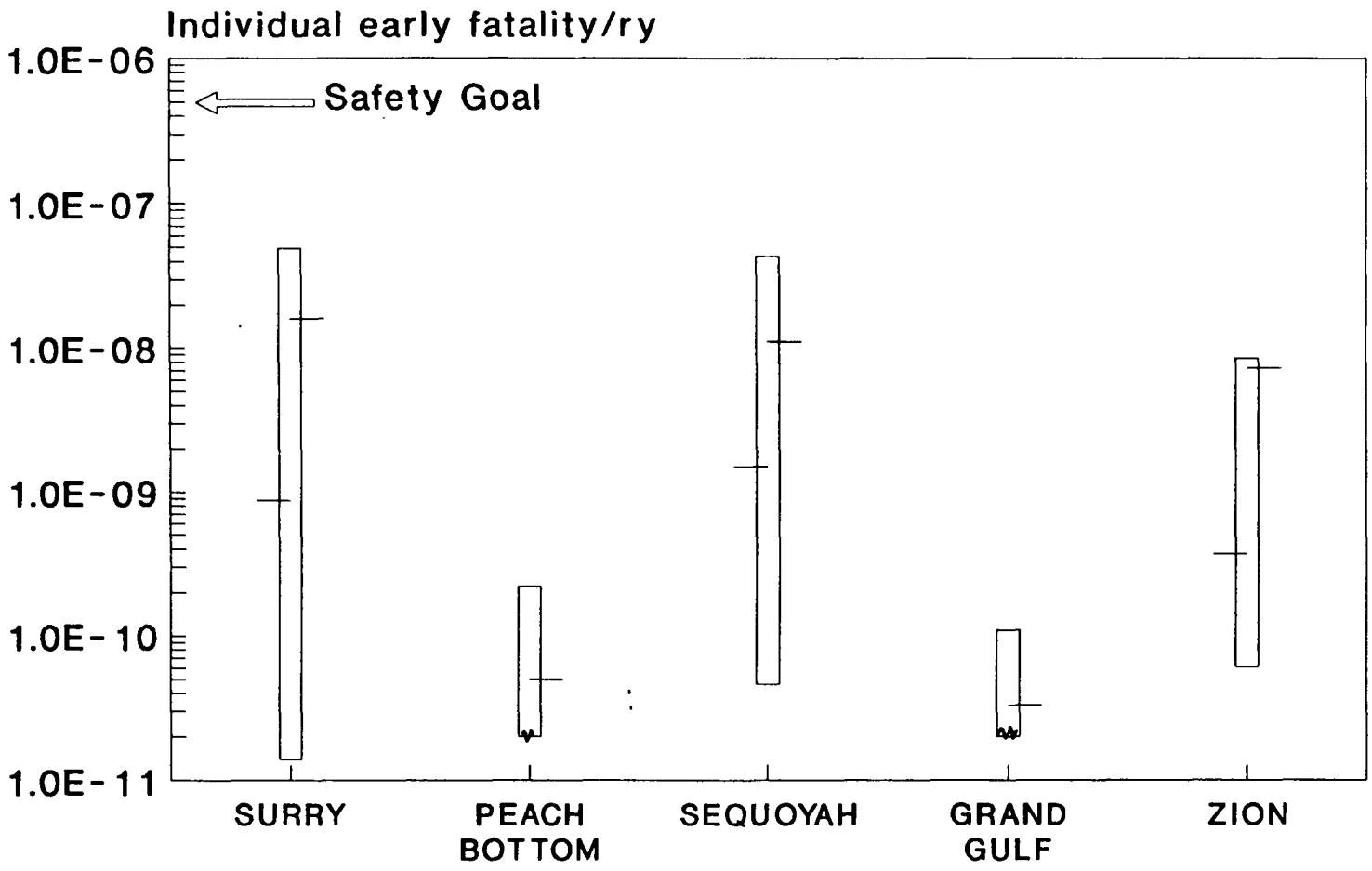
Comparison of source terms with Reactor Safety Study, Surry

Early Containment Failure

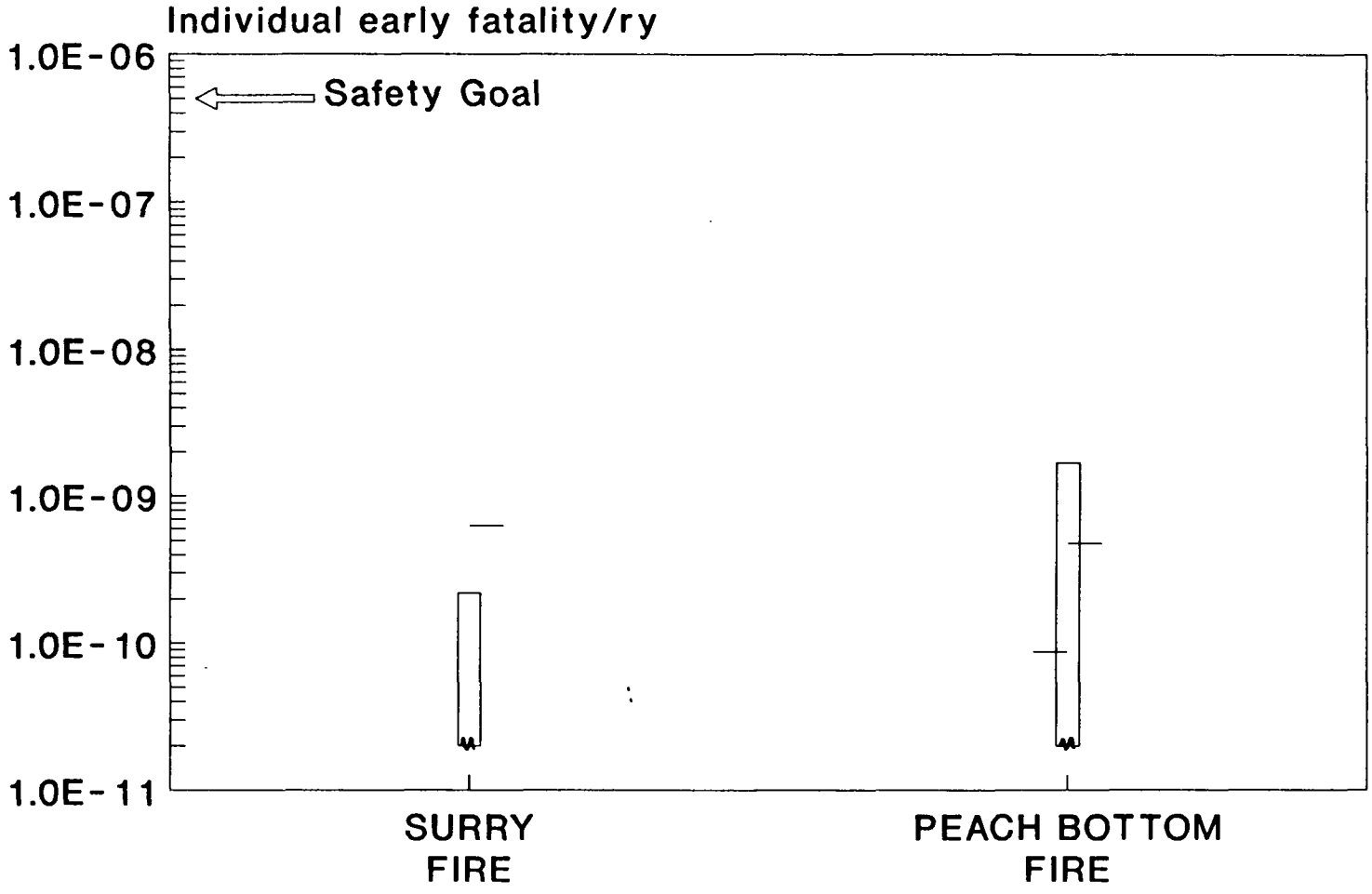


Comparison with Bins BWR2 and BWR3

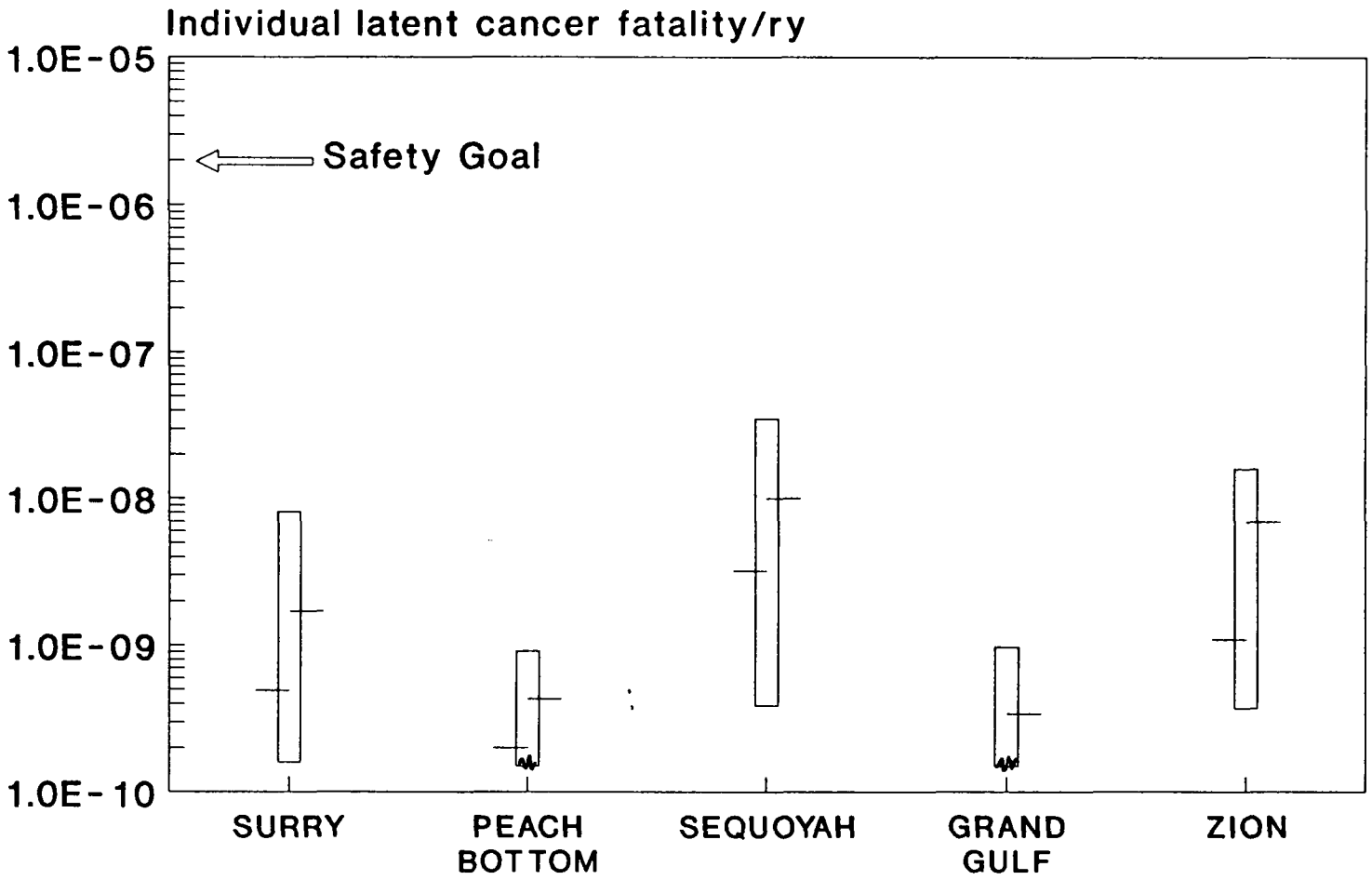
Comparison of source terms with Reactor Safety Study, Peach Bottom



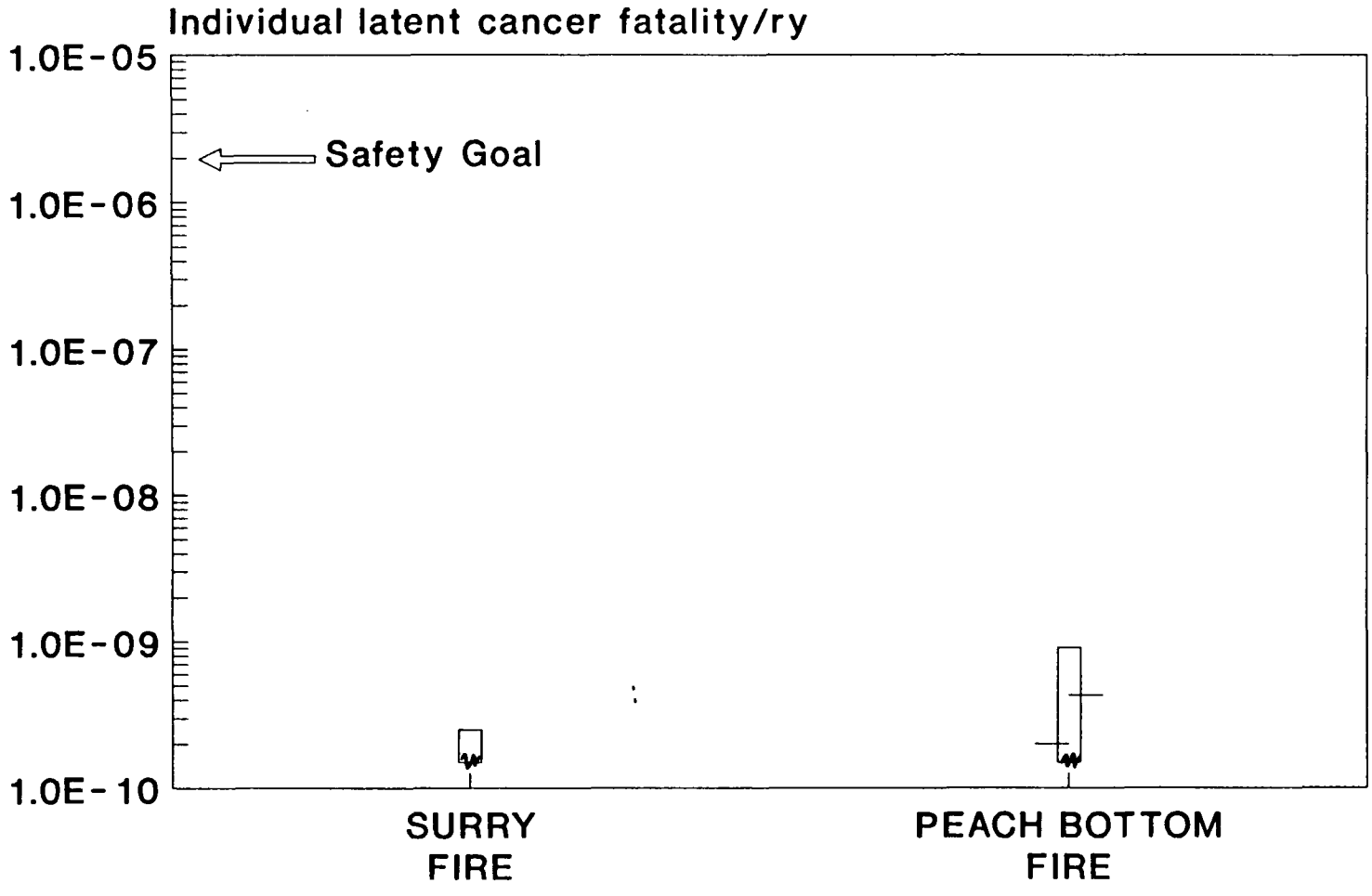
Comparison of individual early fatality risks - all plants (internal initiators)



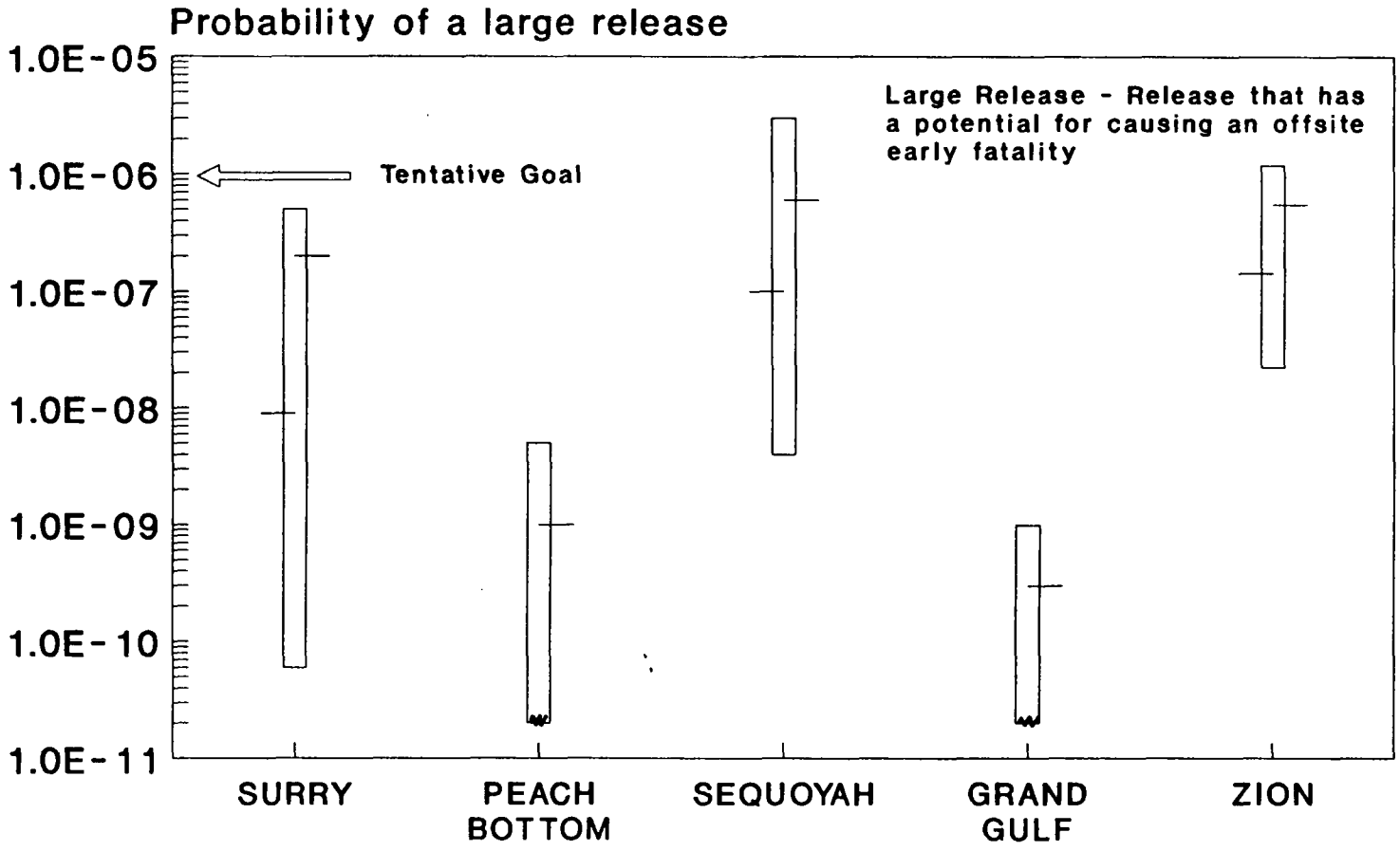
Comparison of individual early fatality risks - Surry and Peach Bottom (fire initiators)



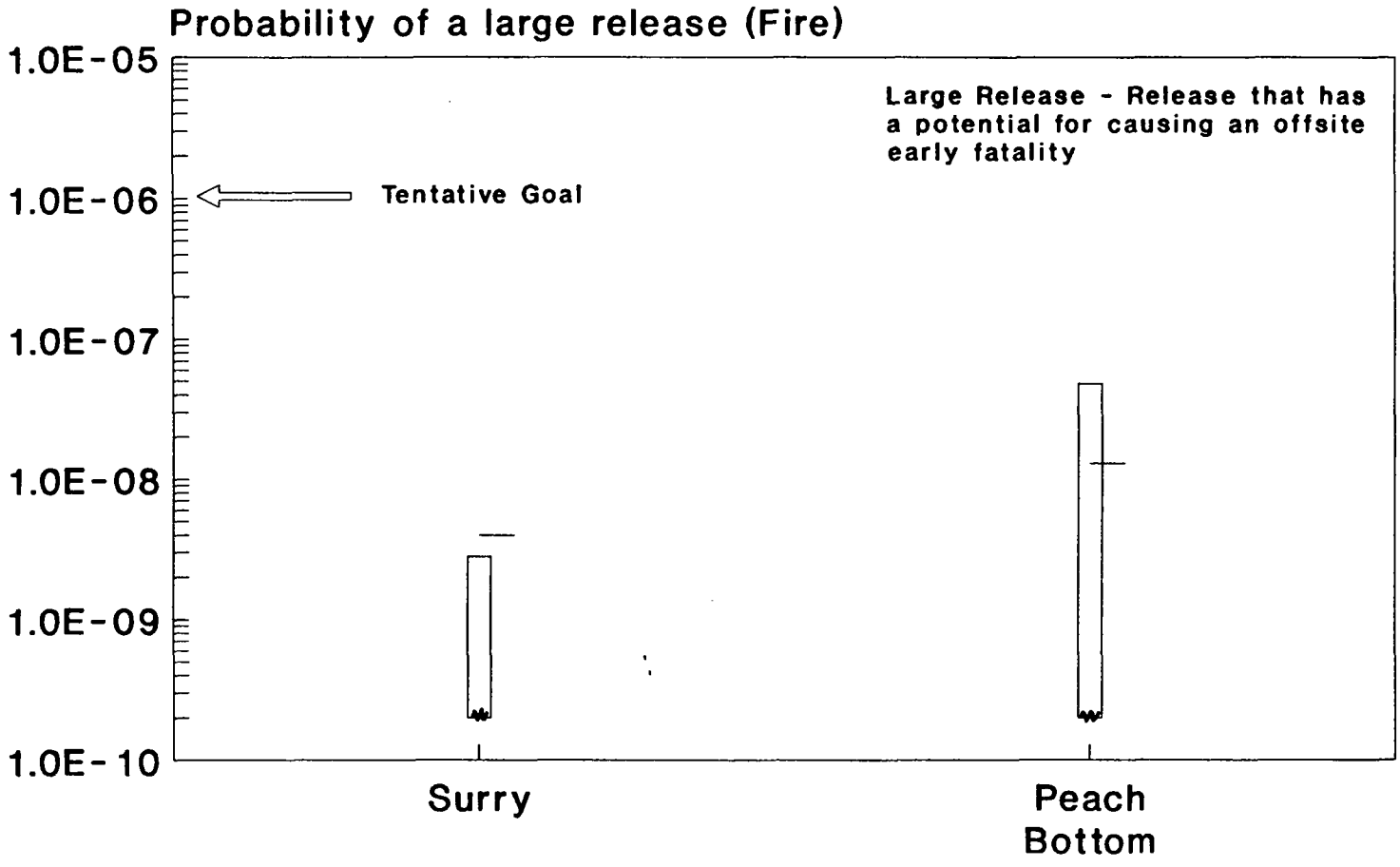
Comparison of individual latent cancer fatality risks - all plants (internal initiators)



Comparison of individual latent cancer fatality risks - Surry and Peach Bottom (fire initiators)



Comparison with tentative safety performance guideline



Comparison with tentative safety performance guideline

Summary

- After final QA, report will be ready to issue as second draft for peer review (June).
- Peer review to begin in July.
- Interim use of report per Commission guidance.
- Plan to complete peer review, modify report as needed and reissue as final report by end of CY 1990.