

Official Transcript of Proceedings
NUCLEAR REGULATORY COMMISSION

Title: Private Fuel Storage, LLC

Docket Number: 72-22-ISFSI; ASLBP No. 97-732-02-ISFSI

Location: Salt Lake City, Utah

Date: Thursday, June 6, 2002

2002 JUN 21 AM 11:18
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Pages 10074-10257

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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of:)
PRIVATE FUEL STORAGE, LLC,)
(Independent Spent Fuel) Docket No. 72-22
Storage Installation)) ASLBP No.
) 97-732-02-ISFSI
)

U. S. Nuclear Regulatory Commission
Sheraton Hotel, Wasatch Room
Salt Lake City, Utah 84114

On June 6, 2002 the above-entitled matter came
on for hearing, pursuant to notice, before:

MICHAEL C. FARRAR, CHAIRMAN
Administrative Judge
Atomic Safety & Licensing Board Panel

DR. JERRY R. KLINE
Administrative Judge
Atomic Safety & Licensing Board Panel

DR. PETER S. LAM
Administrative Judge
Atomic Safety & Licensing Board Panel

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I N D E X

E X A M I N A T I O N

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E X H I B I T S

No. MRKD/ADMTD

STATE'S EXHIBITS

202	(Previously Marked)	/10089
203	(Previously Marked)	/10125
204	(Previously Marked)	/10125
206	(Previously Marked)	/10126
208	(Previously Marked)	/10089
209	(Previously Marked)	/10149

STAFF'S EXHIBITS

SS	Letter dated 3/19/99 from E. William Brach to Warren Bergholz with attached documents	10175/10176
TT	Excerpts from Final Report - Volume I of III, Fault Evaluation Study and Seismic Hazard Assessment, prepared by Geomatrix Consultants, Inc., February 1999.	10179/10181
UU	Pages 1, 12, and 16 of Reg Guide 1.165 dated March 1997	10187/10193
VV	Letter from David J. Modeen, May 25, 1994, with attachments	10194/10196

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June 6, 2002

9:05 a.m.

P R O C E E D I N G S

JUDGE FARRAR: Good morning, everyone.

We have a couple of preliminary matters before we get started. First, we had talked some time ago about Friday, June 21st cashing in my one scheduling check to attend my friend's 60th birthday and wedding in Philadelphia. Rather than have Judge Bollwerk sit in for me, I think what we'd like to do is go from eight to two that day, on Friday, the 21st, and then Judge Bollwerk has contacted us and said he would like to do an EIE demonstration at two o'clock.

MR. GAUKLER: Talking about Friday, the 21st?

JUDGE FARRAR: Yeah.

MR. GAUKLER: We had hoped to be done that week by that time, so it wouldn't impinge at all on your Honor's schedule.

JUDGE FARRAR: Thank you.

MS. CHANCELLOR: We were trying to finish by Thursday.

JUDGE FARRAR: Okay, great. I thought

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1 this -- Judge Bollwerk was trying to make sure we
2 didn't lose time there. But then I will tell him
3 that may not work and he'll have to wait and see.
4 So then that would be a long weekend for everybody.
5 Good.

6 MS. CHANCELLOR: We're still talking
7 about when we're going to start the following week,
8 because from the State's travel it would make a
9 difference if we came in the middle of the week to
10 be able to come back to Salt Lake. But we'll talk
11 about that.

12 JUDGE FARRAR: Okay, we're at your
13 disposal. But the aircraft is certain on the 1st,
14 2nd and 3rd?

15 MR. GAUKLER: Yes, your Honor.

16 JUDGE FARRAR: Last night we had a
17 lengthy discussion after the record closed about
18 the logistical and security arrangements.
19 Mr. Gaukler, you told me you've contacted
20 Mr. Silberg, and even in his vast experience he's
21 not had a hearing there. So what struck me in
22 terms of working with our security and logistics
23 people is a good analogy would have been the state
24 capitol. Mr. Gaukler, how -- if I recall, you all
25 had a room there?

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1 MR. GAUKLER: We had a separate room
2 which was arranged by I guess Parsons, Behle, our
3 local law firm, with the state.

4 JUDGE FARRAR: And you brought a copier
5 in?

6 MR. GAUKLER: We brought a copier in.

7 JUDGE FARRAR: Rented it, or --

8 MR. GAUKLER: We rented a copier, I
9 believe, and brought in a printer. So we had the
10 capability right there to copy and print as need
11 be. And it was right next door, so it was very
12 handy.

13 JUDGE FARRAR: Okay. We're working on
14 the security issues. As I told you, you each have
15 a breakout room, and my colleagues are -- not my
16 colleagues here but my colleagues back home were of
17 the impression that it's bigger than I recall,
18 though I've never spent any time in them, and there
19 certainly would be room for computers and printers.
20 The issue we're wrestling with is access to a large
21 enough copier.

22 Let me ask you all, in the last few days
23 as we've done rebuttal there have been a lot of
24 extra documents that you suddenly pull out.
25 Mr. Soper had some that he used to cross-examine

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1 the witness. Could you have those ready the night
2 before?

3 MS. CHANCELLOR: No, not always.
4 Frequently it's, could somebody please go down to
5 the room and make 12 copies immediately.

6 JUDGE FARRAR: And in a short case or
7 when you're on your direct case, just my
8 observations are you're able to plan a lot better.
9 When we get into the rebuttal it's a lot more
10 shooting from the hip. Well, we'll keep working on
11 our end, and if you go with making it, if not
12 ideal, at least very workable. If anybody has any
13 bright ideas, let us know.

14 Any other preliminary matters? All
15 right, then, Dr. Arabasz.

16 THE WITNESS: Good morning, Judge
17 Farrar.

18 JUDGE FARRAR: Good morning. You're
19 still under oath, consider yourself that way.

20 THE WITNESS: Yes, I do.

21 JUDGE FARRAR: And Ms. Chancellor, I
22 believe you were going to proceed.

23 MS. CHANCELLOR: That's correct.
24
25

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1 REDIRECT EXAMINATION (Continued)

2 BY MS. CHANCELLOR:

3 Q. Good morning, Dr. Arabasz.

4 A. Good morning, Ms. Chancellor.

5 Q. Would you please place in front of you
6 State's Exhibit 207 and State's Exhibit 208. 207
7 is DOE Standard 1020-2002, and I handed this out
8 yesterday, and the second document is Risk
9 Reduction Ratio Mean Return Period of Design-Basis
10 Earthquake, et cetera. Do you have those two
11 documents?

12 A. Yes, I do.

13 MR. TURK: Your Honor, before we have
14 examination on this, I'd like to note that I would
15 object to the introduction of State Exhibit 207.
16 It's a matter that's already in evidence. This is
17 a page from the 2002 DOE standard that the Staff
18 introduced in greater detail, more pages yesterday.
19 I don't have any problem with examination on the
20 Staff's exhibit, but I don't see why we need to
21 introduce the same matter more than once. I have
22 no problem if the State wants to examine based on
23 the Staff's exhibit.

24 MS. CHANCELLOR: I'd just like to
25 comment, your Honor, in an effort to expedite this,

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1 I did note when I identified these exhibits that
2 this was duplicative of the Staff's exhibit, and
3 I'll go forward and examine Dr. Arabasz on State's
4 Exhibit 207. Whether it's introduced or not is a
5 different matter.

6 MR. TURK: Well, I have an objection,
7 your Honor.

8 JUDGE FARRAR: But you can't have an
9 objection to her asking questions about it. You
10 may have an objection if she tries to introduce it.

11 MR. TURK: Well, after she's done asking
12 the questions she'll move to introduce it based on
13 the fact that she's conducted questioning on it.
14 And I would suggest that instead she state simply
15 take Staff Exhibit QQ and examine on the same page.

16 MS. CHANCELLOR: I'm pleased to know
17 that Mr. Turk knows what I'm going to do, your
18 Honor.

19 MR. TURK: I will note my objection,
20 your Honor, and I will strongly voice it again if
21 she tries to introduce the exhibit.

22 JUDGE FARRAR: Let's do this, Mr. Turk.
23 You had lengthy cross-examination of Dr. Arabasz,
24 and while what you say has some merit, I'm
25 reluctant at the very outset to tell the State how

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1 to handle its case. We'll bear your concerns in
2 mind and deal with them appropriately.

3 Go ahead, Ms. Chancellor.

4 MS. CHANCELLOR: Thank you, your Honor.

5 Q. (By Ms. Chancellor) Dr. Arabasz, would
6 you please turn to State's 207, which is a cover
7 page of DOE Standard 1020-2002, and turn to the
8 second page of that exhibit, C-6. In your
9 testimony, Dr. Arabasz, we have attached to it
10 State's Exhibit 128, which is Table C-3 from DOE
11 Standard 1020-2001, correct?

12 A. I don't find it under 128.

13 Q. Okay. I can't read my writing. Just a
14 second.

15 A. Under --

16 Q. 126.

17 A. -- 126 I find it.

18 Q. Yes. The document in front of you,
19 State's Exhibit 207, is that an update of Table C-3
20 in State's Exhibit 126?

21 A. Yes, it is, Ms. Chancellor.

22 Q. Could you please describe Table C-3 with
23 respect to Performance Category 3?

24 A. Yes. And you allowed me to have in
25 front of me also State's Exhibit 208 at the same

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1 time?

2 Q. That's correct.

3 A. Which provides that a useful visual
4 reference, just to understand the terms and also
5 the relationships between probabilities and their
6 inverse.

7 On State's Exhibit 208 there are terms
8 that appear in the DOE Standard 1020 Table C-3: a
9 term risk reduction R sub capital R , which is
10 identified as the risk reduction ratio; a term
11 capital P sub capital H , the seismic hazard
12 exceedance probability, and this has also been
13 referred to during the hearings as the MAPE, the
14 Mean Annual Probabilities of Exceedance of the
15 design-basis earthquake ground motions. And for
16 understanding the inverse of the MAPE or the
17 inverse of the term P sub H is the mean return
18 period.

19 The third term, capital P sub capital F ,
20 is the target seismic performance goal, meaning the
21 annual probability of exceeding acceptable behavior
22 limits.

23 And there's a basic equation that's
24 taken from DOE Standard 1020-2002 at page C-5 where
25 a relationship between R sub R is described, the

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1 equation being $R \text{ sub } R \text{ equals } P \text{ sub } H$, the hazard
2 probability, over $P \text{ sub } F$, the failure probability.
3 So that in the example table at the bottom of State
4 Exhibit 208, for a probability of failure $P \text{ sub } F$
5 of $1 \text{ times } 10 \text{ to the minus } 4$, which is the
6 probability of failure for PC-3, then one can enter
7 the table and see the relationships.

8 For example, in the third column, note
9 that the probability of failure is entered as 1
10 $\text{times } 10 \text{ to the minus } 4$ for all cases. So that if
11 one has a $P \text{ sub } H$ of $1 \text{ times } 10 \text{ to the minus } 4$,
12 reading from the second column in the table, one
13 sees as a convenient reference, looking to the
14 left, that its inverse is a 10,000-year return
15 period ground motion. And if one begins with
16 stipulating a $P \text{ sub } F$ of $1 \text{ times } 10 \text{ to the minus } 4$,
17 if one sets $P \text{ sub } H$ at $1 \text{ times } 10 \text{ to the minus } 4$,
18 then the risk reduction ratio, $R \text{ sub } R$, required to
19 achieve that $P \text{ sub } F$ is 1.

20 Going to the bottom of the table, if the
21 $P \text{ sub } H$ is $5 \text{ times } 10 \text{ to the minus } 4$, in other
22 words, a 2,000-year return period ground motion, to
23 meet that performance goal a risk reduction ratio
24 of 5 is required. And the risk reduction ratio can
25 be viewed as the conservatisms that are achieved on

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1 the design side in the design or evaluation
2 procedures and the acceptance criteria.

3 I'm moving now to Table C-3 appearing
4 identically in State's Exhibit 207, or, as Mr. Turk
5 noted, the Staff Exhibit QQ, I believe. And I
6 discussed with Mr. Turk yesterday the change in the
7 row for Performance Category 3 where the target
8 seismic performance goal remains the same, 1 times
9 10 to the minus 4, but for the term P sub H the
10 seismic hazard exceedance probability in the most
11 recent version of DOE Standard 1020, namely,
12 version 2002, the hazard exceedance probability has
13 been changed. Formerly it was 5 times 10 to the
14 minus 4, a 2,000-year return period, now it is 4
15 times 10 to the minus 4. And the risk reduction
16 ratio to achieve that performance goal would be 4.

17 Now, at least for me personally, as I
18 navigate through this regulatory maze, this is of
19 particular interest to me in that in searching for
20 a fixed R, a fixed reference point, I think I see
21 some fly paper here that, for example, if one had
22 formerly a 2,000-year return period and wanted to
23 reference the updated DOE standard 2002 and be
24 consistent, in other words, if one stayed pinned to
25 2,000 years where DOE Standard 1020 had moved on to

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1 a 2,500-year P sub H, one could only do that and be
2 consistent if one accepted that performance goal of
3 1 times 10 to the minus 4.

4 And this now begins, at least for me, to
5 give some glimmer of a fixed reference point,
6 whereas before, this performance goal had not been
7 acknowledged. I think here we're beginning to see
8 a logic that says if one is to use the DOE Standard
9 1020 as a reference point, that one logically needs
10 to accept that probability of failure.

11 Q. And Dr. Arabasz, did you prepare State's
12 Exhibit 208, the risk reduction ratio, the document
13 you had in front of you?

14 A. Yes, I did, Ms. Chancellor.

15 Q. And is the formula the same as appears
16 in Staff's Exhibit QQ on page C-5, which is from
17 DOE Standard 1020-2002, the R sub R equals P sub H
18 over P sub F?

19 A. That's correct.

20 Q. And the definitions, do they come from
21 DOE Standard 1020?

22 A. Yes, they did.

23 Q. And State's Exhibit 207, which has Table
24 C-3, is that the same as on Staff's Exhibit QQ at
25 page C-6? Is that identical?

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1 A. By my inspection it appears to be
2 identical, yes.

3 MS. CHANCELLOR: Your Honor, I would
4 move for admission of State's Exhibit 208.

5 JUDGE FARRAR: Any objection,
6 Mr. Gaukler?

7 MR. GAUKLER: No objection.

8 JUDGE FARRAR: Mr. Turk?

9 MR. TURK: No objection.

10 JUDGE FARRAR: Then 208 will be
11 admitted.

12 (STATE'S EXHIBIT 208 WAS ADMITTED.)

13 Q. (By Ms. Chancellor) Dr. Arabasz, if you
14 would now turn to State's Exhibit 202, and 202 is
15 the Yucca Mountain Topical Report YMP/TR-003-NP,
16 August 1997. And it refers -- the second page and
17 last page of that exhibit is Table C-2.
18 Dr. Arabasz, is Table C-2 the survey of nuclear
19 power plants in the western United States on which
20 there has been considerable testimony?

21 A. Specifically it's a summary of composite
22 mean exceedance probabilities for nuclear power
23 plants in the western United States, and the result
24 for that -- for this sample of five nuclear power
25 plants, the mean of these mean exceedance

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1 probabilities is greater than 2 times 10 to the
2 minus 4, which, from my cheat sheet on State
3 Exhibit 208, I can readily see that that
4 corresponds to a 5,000-year return period ground
5 motion.

6 MS. CHANCELLOR: Your Honor, we've had
7 considerable testimony about this table. It has
8 not yet been introduced. I would move for
9 introduction of State's 202.

10 JUDGE FARRAR: Any objection?

11 MR. GAUKLER: No objection, your Honor.

12 JUDGE FARRAR: Mr. Turk?

13 MR. TURK: Your Honor, I don't object.
14 It may be that we want to introduce more portions
15 of that report, but I don't object to the
16 introduction of this page subject to that
17 qualification.

18 JUDGE FARRAR: Right, and you'll have
19 that option. Then State 202 will be admitted.

20 (STATE'S EXHIBIT 202 WAS ADMITTED.)

21 MS. CHANCELLOR: Ms. Nakahara is going
22 to hand out two documents. One is a copy of a
23 transcript, transcript pages from May 13 and May
24 17. Second document is taken from Staff's Exhibit
25 JJ, and it is from Dr. Stamatakos's notebook,

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1 comparison of western U.S. hazard curves. I'll be
2 asking him some questions about this.

3 JUDGE FARRAR: These are just courtesy
4 copies?

5 JUDGE FARRAR: These are just courtesy
6 copies, that's correct, your Honor.

7 MR. TURK: Your Honor, while this paper
8 is being passed out, may I note that the State
9 Exhibit 202 is a page from Appendix C to Topical
10 Report YMP/TR-003. That appendix discusses each of
11 the various plants mentioned in the table, and
12 perhaps during the next break I can talk with the
13 other counsel about whether we should just
14 introduce the entire appendix. I'm sorry to
15 interrupt.

16 JUDGE FARRAR: That's all right.

17 Q. (By Ms. Chancellor) Dr. Arabasz, you
18 were here for Dr. McCann's testimony on May 13,
19 correct?

20 A. Correct.

21 Q. On transcript page 8326, Dr. McCann
22 testifies that on line -- beginning on line 8 that
23 a 5,000-year mean return period is not --

24 A. Are you paraphrasing this,
25 Ms. Chancellor?

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1 Q. Yes, I'm paraphrasing. Is not
2 reasonable either because that would be equivalent
3 to the design basis for a nuclear power plant in
4 the west; and Dr. McCann goes on to say that the
5 Staff bracketed the return periods between 5,000
6 and 1,000 years. Is that your understanding of
7 this portion of Dr. McCann's testimony?

8 A. It is.

9 Q. And then in your testimony --

10 MR. TURK: I'm sorry. Did you say the
11 Staff bracketed between 5,000 and 1,000?

12 MS. CHANCELLOR: That's what Dr. McCann
13 testified to.

14 Q. (By Ms. Chancellor) Now, in determining
15 whether to grant the 2,000 years, Dr. McCann
16 testified that they looked at the upper range of
17 5,000. Dr. Arabasz, could you explain what your
18 understanding of Dr. McCann's testimony is on page
19 8326?

20 A. That what Dr. McCann is offering, in my
21 understanding, was a rationale for justifying the
22 2,000 years with respect to two end points: a
23 1,000-year ground motion which the Staff had
24 earlier rejected because there did not appear to be
25 sufficient regulatory or technical basis for

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1 accepting it, and on the upper end, a reference
2 probability for a nuclear power plant.

3 And he states -- I'm reading beginning
4 on line 12 of page 8326, "And in our consideration
5 we now need to be away from 5,000 years and
6 considerably away from 1,000 years." And he goes
7 on to explain -- well, let me just continue
8 reading. Perhaps that's easiest.

9 Continuing on line 14, "And if you begin
10 to look at that, 10 percent, 20 percent not being
11 much of a difference at all, factors of one and a
12 half to two being a reasonable change in
13 probability of exceedance, so being a factor of two
14 away from 10 to the minus 3 brings us to 5 times 10
15 to the minus 4, and being a factor of two away from
16 2 times 10 to the minus 4 brings us 4 times 10 to
17 the minus 4, and thus we concluded that 2,000 years
18 was appropriate."

19 And I guess I'm cursed or blessed,
20 depending on point of view, with needing to sort of
21 see the big picture. And to my understanding
22 coming into this hearing, I was aware, for example,
23 of an item that the Applicant had outlined as one
24 of its key determinations for Section E. And it's
25 in item 5 and it reads, "The average mean safe

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1 shutdown earthquake ('SSE') for a typical NPP of
2 approximately 1 times 10 to the minus 4 is the
3 appropriate NPP benchmark on which to determine the
4 higher probability of seismic failure allowed for
5 ISFSIs." And I was also aware that fairly
6 consistently its rationale put forward for
7 justifying the 2,000-year return period that the
8 Staff in the various versions of the SER had
9 basically said that the design-basis motion for an
10 ISFSI relative to a nuclear power plant could be
11 less than 1 times 10 to the minus 4.

12 And I was also aware -- excuse me. As
13 documented in Staff Exhibit S, and this is
14 SECY-98-071, where on the second page of the
15 document, which is a, I assume a memorandum or a
16 letter from L. Joseph Callan to the Commission
17 dated April 8th, 1998 regarding the TMI-2 ISFSI
18 exemption, on the second page of Staff Exhibit S in
19 the bottom-most paragraph and in the middle of the
20 paragraph there's text that states, "Based on 10
21 CFR 100.23 requirements as described in Regulatory
22 Guide 1.165, 'identification and characterization
23 of seismic sources and determination of safe
24 shutdown earthquake ground motion,' a future
25 nuclear power plant in the western United States

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1 can use as a safe shutdown earthquake the
2 10,000-year return period mean ground motion."

3 And given this context, this is where
4 the reference point for the nuclear power plant
5 appeared to be an important element of
6 consideration before the Board.

7 Q. And you testified on May 17 that you
8 thought that the Staff were on shaky ground if they
9 associated a 5,000-year with a design-basis
10 earthquake for a nuclear power plant that may be
11 sited in the -- certainly the Intermountain Area of
12 the western United States; is that correct?

13 A. That was my opinion and it is still my
14 opinion.

15 Q. And that appears in the transcript at
16 9116 -- 9169. With that in mind, Dr. Arabasz,
17 where the 5,000-year mean annual probability of
18 exceedance should be defined, maybe we can do a
19 tour of some nuclear power plant sites. Is it
20 your -- could you explain once again the epiphany
21 you had with plate boundaries, just so that we can
22 frame the issue?

23 A. The awareness I came to was that when
24 faced with Table C-2, which had been compiled by
25 the Department of Energy here, and this is in

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1 State's Exhibit 202, and produced in an appendix,
2 in Appendix C of Yucca Mountain Topical Report 2,
3 the Department of Energy at the time was attempting
4 to justify a design-basis motion of 1 times 10 to
5 the minus 4 at Yucca Mountain, in effect equating
6 it to the reference probability for a nuclear power
7 plant. And they looked at information available to
8 them for five nuclear power plants identified in
9 Table C-2, and that information led them to
10 determining a composite mean exceedance probability
11 where it says the probability of exceeding the
12 design-basis motions or the design-basis response
13 spectrum for those plants, the average of the
14 exceedance probability at spectral ordinants 5 Hz
15 and 10 Hz, and then taking the arithmetic average
16 with the result that for these existing plants in
17 the United States -- excuse me -- in the, quote,
18 western United States, end quote, those quotes are
19 mine, the bottom line, the mean exceedance
20 probability was greater than 2 times 10 to the
21 minus 4, or let's say on the order of a 5,000-year
22 return period.

23 Q. And was it your testimony that there is
24 a dearth of information for sites in the
25 non-coastal areas of the western United States?

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1 A. Correct. And as I explained relating to
2 the use of my word "epiphany" was that we had a
3 sample of nuclear power plants, at least three of
4 which, in my mind, clearly were along the western
5 coast of the United States or in an area where
6 under the DOE framework they would be identified
7 as -- see if I can remember the wording -- near a
8 tectonic plate boundary. And then I recognized
9 that the Palo Verde plant west of Phoenix in
10 Arizona was away from the plate boundary, and we
11 had heard earlier in testimony that its return
12 period or its exceedance probability of 3.8 times
13 10 to the minus 5 per year corresponded to
14 something in the order of a 26,000-year ground
15 motion, making that particular plant an outlier.

16 I then made a generalization about the
17 remaining plants appearing to be influenced by
18 their proximity to the plate boundary. We went
19 through a long walk-about through the western
20 United States with Mr. Turk, and what he correctly
21 prodded me to was to examine Washington Nuclear
22 Plant 2 and whether that in fact was near a plate
23 boundary. And on further reflection, or actually
24 an awareness which had escaped me before, that the
25 Washington Nuclear Plant 2, which was sited on the

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1 Hanford reservation, a major DOE facility, was away
2 from the plate boundary.

3 Q. And in State's Exhibits 203 through 206,
4 did you use these -- this information to try and
5 fill in some of the gaps with respect to
6 information in the non-coastal areas of the western
7 United States?

8 A. Correct. And in my examination by
9 Mr. Gaukler, for example, I was asked to estimate
10 whether the reference probabilities should be
11 approximately 1 times 10 to the minus 4. And in
12 that context, if I remember correctly, or in
13 replying to Mr. Turk, I explained at some point
14 that I had information from coastal western United
15 States, I had information from the central and
16 eastern United States, and what was missing was
17 information elsewhere eastward of the plate
18 boundary and into the intermountain area.

19 Q. Let's turn to State's Exhibit 203, which
20 is the cover page Basis for Seismic Provisions of
21 DOE Standard 1020 prepared by Kennedy and Short in
22 April of 1994. And the second page which goes to
23 the last page of the exhibit, No. A, page No. A-4
24 has a Table A-2, and then there's some annotations
25 at the bottom of Table A-2. Dr. Arabasz, did you

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1 prepare the annotations on this table?

2 A. I did, Ms. Chancellor.

3 Q. And I don't know whether it would be
4 preferable for you to describe A-2 first and then
5 describe the annotations. I'll let you choose
6 which way to -- which would be easier to describe
7 that.

8 A. I'm pausing for a moment to refer to the
9 source, a report prepared by Robert C. Kennedy and
10 Stephen A. Short which is referenced in DOE
11 Standard 1020-2002 and earlier versions. The
12 report is titled "Basis for Seismic Provisions of
13 DOE-STD-1020."

14 Q. Maybe just to start with, Dr. Arabasz,
15 could you tell us in general, what is Table A-2?
16 Can you give us an overview of this table?

17 A. Yes. It gives an overview of the slopes
18 of seismic hazard curves and how they vary across
19 the country. And I just wanted to be able to state
20 more -- I wanted to be able to state precisely what
21 the term A sub R means or how it's defined. And
22 I'm reading from page 2-1 in the Kennedy and Short
23 paper. And there is an equation 4 which reads, "K
24 sub H equals 1 over log (A sub R)." And to guide
25 the Board, let's consider the hazard curves -- is

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1 this Staff's Exhibit JJ? Is that correct?

2 Q. Yes. It's a page from Dr. Stamatakos's
3 notebook, comparison of western U.S. hazard curves.
4 And yes, it was Staff's Exhibit JJ.

5 A. The first thing to observe on the graph
6 of hazard curves is the Y axis is logarithmic and
7 the X axis is normal. So that when we view a
8 hazard curve in this form, generally we're looking
9 at a ski slope kind of configuration. Most of it
10 the curves concave up with the exception for the
11 San Francisco Bay Bridge.

12 And the term "A sub R," now I'll return
13 to Kennedy and Short, page 2-1 beginning right
14 after the equation 4, again K sub H equals 1 over
15 log A sub R. It reads, "In which A sub R is the
16 ratio of ground motions corresponding to a tenfold
17 reduction in exceedance probability." And one
18 recognizes in looking at a hazard curve such as
19 displayed on Staff's Exhibit JJ that the slope of
20 the hazard curve changes depending on the
21 probability interval that one's examining. And in
22 the Table A-2 in Kennedy and Short there's a term
23 A_5/A_4 , and what that is is a ratio of the ground
24 motions corresponding to a change from 10 to the
25 minus 5 to 10 to the minus 4. So that if one

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1 measured the ratio of the change in ground motions
2 over that interval, in Kennedy and Short format it
3 would be designated A5/A4.

4 And this part of the hazard curve, this
5 particular slope would be relevant to looking at
6 PC 4 facilities or where one is looking at a factor
7 of safety beginning at 10 times -- excuse me -- 1
8 times 10 to the minus 4 where in effect you're
9 standing on the ski slope at the point of 10 to the
10 minus 4 and you know that you want to go down slope
11 to consider a margin of safety, and so the
12 appropriate part of the slope to be referring to is
13 this A5/A4 slope.

14 Correspondingly, if one measured the
15 ratio between 10 to the minus 3 and 10 to the minus
16 4, you'd end up with a measurement that would be
17 designated A4/A3, and this would be appropriate if
18 you were considering the slope of a hazard curve
19 for PC 3 where now you're standing on the ski slope
20 at 1 times 10 to the minus 3, you know that you
21 want to go down the ski slope to the right, and the
22 part of the slope that you're concerned with is the
23 interval between 10 to the minus 3 and 10 to the
24 minus 4.

25 Q. That's very helpful. Thank you,

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1 Dr. Arabasz. And with respect to the
2 annotations --

3 JUDGE FARRAR: Ms. Chancellor, let me
4 interrupt. It's very helpful, but I'm missing one
5 piece. I think I understand everything you just
6 said, but what does the ratio represent? I mean, I
7 understand it represents a change in the slope, but
8 what -- and there are no units to the number, but
9 take the top number there, 2.26. Is that
10 transformed into the slope of the line at that
11 point? Or are we doing, comparing these ratios,
12 that the ratios only mean something in relation to
13 each other? Or ask -- or if I'm not asking the
14 right question, ask the right question and give me
15 the answer.

16 THE WITNESS: If you want to think of it
17 in terms of a slope term, then if we look in
18 log-log space, one may encounter a hazard curve
19 which doesn't look like a ski slope but which it's
20 convexed upward. And there, if you take the log of
21 A sub R and its inverse, then you get the negative
22 slope of the hazard curve in log-log space.

23 But in either depiction the important
24 thing is the relative change in ground motion for a
25 decade change in probability. And this becomes

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1 extremely important in the rationale as described,
2 for example, revisiting Dr. Cornell's testimony of
3 what happens with a margin when you are at a point
4 in the hazard curve and you move to the right,
5 depending on how the ground motion changes as you
6 move to the right, you can end up with differing
7 degrees of conservatism as it relates to the
8 probability of failure.

9 JUDGE FARRAR: Hold a second,
10 Ms. Chancellor.

11 (The Board confers off the record.)

12 JUDGE LAM: Dr. Arabasz, now, the ratio
13 A5/A4, could you just walk us through just picking
14 some value of this to show us how that ratio is
15 determined?

16 THE WITNESS: Yes. Okay, let me take
17 the curve for Hanford A on Staff Exhibit JJ. And I
18 will pick the point along the hazard curve at the
19 intersection with 10 times -- excuse me, 1 times 10
20 to the minus 5, and I enter the curve on the Y axis
21 at 10 to the minus 5, and then I read on the X axis
22 a ground motion value of 700 --

23 JUDGE LAM: Okay.

24 THE WITNESS: -- units. Now I will
25 enter the curve at 1 times 10 to the minus 4 on the

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1 same curve and intersect the curve for Hanford A
2 and read approximately 400 units.

3 JUDGE LAM: Okay.

4 THE WITNESS: So that for my parameter
5 A5/A4, I would have 700 divided by 400, giving me a
6 slope of 1.75.

7 JUDGE LAM: So the ratio A5/A4 is the
8 slope? A5/A4 is the slope between 10 to the minus
9 4 and 10 to the minus 5?

10 THE WITNESS: I don't think quite true,
11 because if we had -- well, let's see. Okay, Delta
12 X over Delta Y, here our Delta X is 300. So that
13 to go to the slope, we take the log and then its
14 inverse.

15 JUDGE FARRAR: The number is not the
16 slope. I think that's where I was confused before.

17 THE WITNESS: It is a slope if you're in
18 log-log space and use the K sub H term.

19 JUDGE LAM: Okay, thanks.

20 Q. (By Ms. Chancellor) Dr. Arabasz, with
21 respect to Staff's Exhibit JJ, would it be correct
22 to say that the change is the inverse of the slope?

23 MR. TURK: I would object. I don't
24 understand the question when you say "the change."

25 JUDGE FARRAR: Can you --

1 Q. (By Ms. Chancellor) The A sub R, the A
2 sub R would be the inverse of the slope; is that
3 correct?

4 A. Let's see. It would be the inverse log
5 of the inverse of the slope. Just to track it
6 safely, I would just follow their definition. The
7 A sub R term understood as a change, a ratio of the
8 change in ground motion. If you want to look at
9 slope in log-log space, go to the K sub H term.

10 Q. So the change in ground motion and a
11 decade change in probability, this ratio that we're
12 talking about, that's the important point?

13 A. That's the important point, yes,
14 Ms. Chancellor.

15 Q. And so as A sub R increases, the slope
16 decreases. Is that correct?

17 A. That is correct. Higher A sub R -- let
18 me see if I've got this -- higher A sub R, lower K
19 sub H.

20 Q. And P sub H is --

21 A. Let me try this one. Okay, the -- let's
22 take, okay, the Skull Valley soil site, for
23 example. The curve -- on Staff Exhibit JJ, the
24 curve for Skull Valley soil that one would
25 intuitively recognize as having a lower slope

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1 compared let's say to the San Francisco Bay Bridge
2 which intuitively appears to have a steeper slope,
3 the -- okay. Let me untangle myself. The A sub R
4 value would be greater for Skull Valley than the
5 San Francisco Bay Bridge by comparison.

6 Q. Thank you. And you annotated State's
7 Exhibit 203 with San Onofre Washington Nuclear
8 Power Plant 3, Washington Nuclear Power Plant 2,
9 Palo Verde and Yucca Mountain. Is that correct?

10 A. That's correct. Basically what I did is
11 I went to information in the topical report to
12 Appendix C and used hazard curves or tables
13 available there, for my purpose, to flesh out the
14 information needed to see what the slopes were at
15 the other nuclear power plants and at some other
16 sites in the western United States. And I wasn't
17 attempting to definitively solve this problem here,
18 and so I represent two significant figures here.

19 Q. And the overall information you can
20 obtain from both your annotations in Table A-2 with
21 respect to whether a nuclear power plant sited, a
22 new nuclear power plant sited at any one of these
23 sites, what does that tell you?

24 A. Within the context of the DOE Table C-3
25 -- I refer now to State Exhibit 207. And for PC 4,

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1 which I would assume would be equivalent to a
2 commercial power plant, will be allowed a hazard
3 exceedance probability of 1 times 10 to the minus 4
4 10,000-year ground motion if a risk reduction ratio
5 of 10 is achieved, for those plants, for those DOE
6 sites that are identified by footnote 1 as, quote,
7 near tectonic plate boundaries, where the risk
8 reduction ratio of 20 or more is achieved and one
9 can justify a lower design-basis ground motion of 2
10 times 10 to the minus 4, or 5,000 years. So that
11 in effect one needs a steep hazard curve to get
12 your risk reduction ratios with a factor of 20 or
13 more in this DOE guidance to justify the 5,000-year
14 ground motion versus a 10,000-year ground motion.

15 Now, when I come to the table in State
16 Exhibit 203, I note a segregation in the table that
17 Kennedy and Short had outlined. They had entries
18 first entered under a category of eastern DOE
19 sites, then western DOE sites not near tectonic
20 plate boundaries that they provide information for
21 INEL, LANL, Los Alamos and Hanford. Then -- and
22 incidentally, in that category I infer it because
23 Washington Nuclear Power Plant 2 sited on the
24 Hanford reservation, I'm assuming that it has
25 comparable slope characteristics to its hazard

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1 curve, is that, analyzed here by Kennedy and Short,
2 would not fall into this category of having a slope
3 ratio that would justify a high -- that would have
4 a high risk reduction ratio and hence justifying
5 the 5,000-year return period.

6 Then continuing on Kennedy and Short's
7 table, high seismic sites near tectonic plate
8 boundaries, so information is provided for LLNL,
9 Lawrence Livermore National Lab in Livermore,
10 Diablo Canyon, and we note that for LLNL the slope,
11 the A5/A4 value is 1.55, for Diablo Canyon 1.36.

12 Then coming down into my annotated
13 entries, I estimate that for San Onofre the A5/A4
14 value would be in the order of 1.5, Washington
15 Nuclear Power Plant 3 near Satsop 1.5. And we can
16 see the similarities to the DOE sites LLNL and
17 Diablo Canyon Nuclear Power Plant site that were
18 enclosed in the category of high seismic sites near
19 tectonic plate boundaries.

20 Then there was not information in
21 Appendix C of Yucca Mountain Topical Report 2 for
22 the Washington Nuclear Power Plant 2 at Hanford,
23 and what I simply -- I put a lined entry and would
24 just look by analogy to the entry farther up in the
25 table for Hanford under western sites not near

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1 tectonic plate boundaries, whether that is 2.01.

2 Then for Palo Verde my estimate of A5/A4
3 is in the order of 2.3, and for Yucca Mountain,
4 going to a published PGA hazard curve, I estimated
5 an A5/A4 value of 2.4.

6 Q. And Palo Verde's in Arizona, correct?

7 A. That's correct.

8 Q. So the values are 1.15 range. What
9 would be the return period for a new nuclear power
10 plant planted at soil clay (phonetic)?

11 A. Under the DOE framework using Table C-3,
12 one would achieve large risk reduction ratios that
13 would justify the use of the 5,000-year P sub H
14 value. When we have slopes of the order of 2 in
15 A5/A4 space, for example, under western DOE sites
16 not near tectonic plate boundaries, INEL, Los
17 Alamos, Hanford, the assumption is that the
18 engineering judgment was made as part of the DOE
19 design approach that these A5/A4 slopes did not
20 justify the 5,000-year return period motion.

21 Q. And for INEL, is there information in
22 either State's Exhibit 127 or Staff's Exhibit S
23 that would help you flesh out whether any nuclear
24 power plant sited there should be 10,000 or 5,000?

25 A. There I can begin to consider some other

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1 information, and I can go back to the line of
2 reasoning that considers the exceedance probability
3 of the design-basis motion. And for the nuclear
4 power plants, the design-basis response spectrum is
5 clearly available and was established as part of
6 licensing.

7 Elsewhere I might consider the
8 proposition of the design-basis motion being
9 equivalent to the 84th percentile deterministic
10 motion. And this in effect is the proposition of
11 using as a proxy for the design-basis motion where
12 one does not have a nuclear power plant the
13 Appendix A guidance or regulation which would give
14 you the 84th percentile deterministic motion as the
15 anchor, if you will, for setting the level of the
16 response spectrum. And we have on the record, I
17 believe it's included in my prefiled testimony
18 under Exhibit 127, and I'm looking at the third
19 page of the exhibit, which is an excerpt from a
20 report prepared by Chen and Chowdhury.

21 MR. TURK: I'm sorry. Which exhibit are
22 you looking at?

23 THE WITNESS: I'm looking at 127.

24 Q. (By Ms. Chancellor) And this is page
25 4-1 of State's Exhibit 127?

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1 A. That's correct, a report prepared for
2 the Nuclear Regulatory Commission titled "Seismic
3 Ground Motion at Three Mile Island Unit 2,
4 Independent Spent Fuel Storage Installation site in
5 Idaho National Engineering and Environmental
6 Laboratory--Final Report."

7 MR. TURK: Could we pause for a moment
8 while we get the documents out?

9 THE WITNESS: Certainly.

10 MR. TURK: Which page of State Exhibit
11 127 are you pointing to?

12 THE WITNESS: Correct.

13 MR. TURK: Which page?

14 THE WITNESS: The third page labeled
15 4-1.

16 MS. CHANCELLOR: Do you have it,
17 Mr. Turk?

18 MR. TURK: I do now. Thank you.

19 THE WITNESS: The last sentence in the
20 third paragraph reads, "The resulting 50th- and
21 84th-percentile deterministic values of PHAS at the
22 proposed TMI-2 ISFSI site are 0.34 g and 0.56 g,
23 respectively." So we have a .56 g 84th percentile
24 deterministic value.

25 If we wanted to compare that to PSHA

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1 results, we would then go to the last sentence in
2 the following paragraph that reads, "Based on this
3 study, the PHAs for the proposed TMI-2 ISFSI site
4 are 0.23, 0.30, and 0.47 g for return periods of
5 1,000, 2,000, and 10,000 years, respectively." So
6 qualitatively one would recognize that the 84th
7 percentile ground motion to .56 g would be higher
8 than a 10,000-year motion. So this is giving me a
9 sense of calibrating, if you will, what the
10 exceedance probability of a hypothetical
11 design-basis motion might be at the INEEL site.

12 Q. So if a nuclear power plant were to be
13 sited at INEL, is it your opinion -- what is your
14 opinion of what the mean annual return -- mean
15 annual probability of exceedance would be?

16 A. First I'd say clearly yet to be
17 established by regulatory decision making, but we
18 do have the Staff informing the commissioners in
19 the INEL exemption that if a new power plant were
20 built at that site that it could use the
21 10,000-year ground motion. But please don't
22 confuse -- okay, what we're dealing with is
23 uncertainties in regulatory guidance. If it were a
24 done deal, what the reference probability of an NPP
25 in the western United States was, we would have

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1 eliminated lots and lots of discussion in this
2 hearing. So there's clearly -- there is evolution
3 in thinking, benchmarks yet to be clearly
4 established, and so when we go back to Dr. McCann
5 benchmark, we just have to take into account these
6 considerations, whether that is a judgment or
7 whether indeed that's the benchmark that the NRC
8 would use.

9 Q. So the exercise we're going through now
10 is your effort to show through hazard curves what
11 the ground motion should be in the western United
12 States for sites that are not near tectonic plate
13 boundaries?

14 A. What I'm suggesting is that going to the
15 Yucca Mountain Topical Report 2, taking the
16 statistics from that Table C-2 and then
17 extrapolating that beyond the plate boundary to the
18 rest of the western United States to 105 degrees, I
19 think it is not a given proposition. That is
20 certainly one subject to challenge.

21 Q. And let's look at the PFS site. Would
22 you turn to State's Exhibit 204. State's Exhibit
23 204 is Updated Deterministic Ground Motion
24 Assessment, Revision 1, by Geomatrix, April 2002.
25 Has Figure 2 and Figure 3.

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1 A. Mercifully, I found it and have it in
2 front of me.

3 Q. There's too much paper over there.

4 A. Here, these are --

5 MR. TURK: I'm sorry; is there a
6 question pending?

7 MS. CHANCELLOR: Yes. I'm asking
8 Dr. Arabasz to explain based on the Geomatrix
9 updated ground motions in State's Exhibit 204,
10 looking at the Figure 2 and Figure 3 of the
11 exhibit, what the curves here would tell him with
12 respect to siting a hypothetical nuclear power
13 plant at Skull Valley site.

14 A. The curves that are shown here are --
15 this would be the composite graphs, and in each
16 graph there is a solid line curve which is the 84th
17 percentile deterministic ground motion for the east
18 fault which governs the DSHA.

19 Now, here you have to set aside the
20 issue of the validity of this DSHA and what its
21 level of conservatism was with respect to Appendix
22 A requirements. But just to continue my
23 qualitative examination of the western United
24 States, I look at this graph and I see that the
25 deterministic 84th percentile ground motions, which

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1 I would use again as a proxy for the SSE ground
2 motions at the site, they're compared with the
3 horizontal response spectra for default normal
4 component on Figure 2 and then with respect to
5 default parallel component on Figure 3. And if I
6 were to look at the spectral ordinants for 5 Hz,
7 namely .2-second period, and 10 Hz for .1-second
8 period, I would observe qualitatively that the
9 deterministic 84th percentile ground motion were
10 closer to the 10,000-year equal hazard spectrum in
11 each case, closer to the 10,000-year compared to
12 the underlying 5,000-year spectrum.

13 In other words, as both the Staff and
14 the Applicant have represented, the deterministic
15 ground motion falls between the five and ten
16 thousand-year equal hazard spectra values, but as I
17 go on to observe again qualitatively I infer a
18 value approaching 10,000 years, perhaps something
19 in the order of 8,000 plus years, eight to nine
20 thousand years.

21 Q. And continuing a qualitative examination
22 of the western United States, would you turn to
23 State's Exhibit 205, which first page is an e-mail
24 communication, and then there are a total of five
25 pages. From the information -- what information

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1 contained in 205 did you obtain with respect to
2 your qualitative examination of the western United
3 States and what the ground motion should be for a
4 hypothetical nuclear power plant at the Yucca
5 Mountain site?

6 MR. TURK: Before a question is given,
7 may I ask the witness first to identify, what is
8 this exhibit? So we understand what we're looking
9 at. And then I would -- if the State would permit,
10 I would just ask the reporter to read back the
11 question the State asked.

12 MS. CHANCELLOR: I have no objection to
13 that, your Honor.

14 JUDGE FARRAR: Go ahead.

15 THE WITNESS: The first page of the
16 exhibit has an e-mail correspondence between myself
17 and Ivan Wong, the project manager for the Yucca
18 Mountain PSHA. Ivan Wong is a seismic hazard
19 expert at US Corporation in Oakland, California, as
20 identified or as apparent in his e-mail address.

21 MR. TURK: And the cover page appears to
22 have several different messages. Could you
23 identify which one is from which person?

24 THE WITNESS: Yes. The context is that
25 DSHA results, to my awareness, had not been

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1 published for Yucca Mountain, so I sent an e-mail
2 message to the project manager asking if such
3 information were available, and he responded. And
4 these -- his response is identified by the right
5 point -- all of the lines that have to their left
6 the right-pointing arrow.

7 And he responds to me, "Walter, a DSHA
8 done by the USGS using the experts seismic source
9 characterization and attenuation relationships
10 results in the following values for a M," meaning
11 magnitude, "6.7 on the Solitario Canyon-Fatigue
12 Wash-Windy Wash fault system for the reference rock
13 outcrop." And here the reference rock outcrop is
14 the base of the repository level.

15 MR. TURK: And is that -- may I ask, is
16 that the controlling fault or the deterministic
17 seismic hazard analysis for Yucca Mountain?

18 THE WITNESS: The controlling fault --
19 I'll take care. I'm not certain.

20 MS. CHANCELLOR: Your Honor, if I just
21 may interject. I didn't realize that Mr. Turk was
22 asking to voir dire a witness. The purpose of the
23 information is for Dr. Arabasz, as he has
24 testified, to do a qualitative examination in the
25 western United States. And Dr. Arabasz has -- is

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1 not claiming that this is -- this is an analytical
2 study of western United States sites. It is a way
3 in which he is trying to satisfy himself with
4 respect to the 5,000 versus 10,000 years.

5 I won't object to some questioning
6 about -- I don't want to get -- I don't think it
7 serves any purpose for us to get bogged down in
8 controlling faults and et cetera when we're looking
9 at a qualitative rough count, if you will.

10 JUDGE FARRAR: Okay. Well, the question
11 was simply from Mr. Turk to help explain what this
12 document is. I think you were going through the
13 e-mail, and I take it when you got this reply you
14 responded to Mr. Wong to detect an error in his
15 calculation; he said, thanks, you're right, and did
16 that correction make it into the final report? In
17 other words, is the report as published an error,
18 or did your suggested correction catch it before it
19 was published?

20 THE WITNESS: I don't know. To my
21 awareness, this is not published information. What
22 I was seeking was companion DSHA information to
23 relate to published PSHA information.

24 I can answer Mr. Turk's question this
25 way, that I am aware that the Solitario fault

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1 system has the highest slip rate of the Yucca
2 Mountain group. Its slip rate is, for example, in
3 the order of .03 to .04 millimeters a year order of
4 magnitude larger than the other Yucca Mountain
5 faults in the near vicinity of the repository, and
6 the controlling earthquake for 5 to 10 Hz range is
7 approximately a magnitude 6.5 or less event within
8 15 kilometers of the site.

9 JUDGE FARRAR: Mr. Turk, is this a
10 sufficient answer for now?

11 MR. TURK: I appreciate the answer from
12 Dr. Arabasz, but I would have a problem with the
13 exhibit's admission or questioning of the exhibit,
14 because, to my knowledge, DOE has not yet submitted
15 to the NRC a deterministic seismic hazard analysis
16 which would indicate what is the controlling fault
17 and what is the magnitude of the seismic event or
18 the slip rates.

19 JUDGE FARRAR: But if the witness knows,
20 he can talk about that.

21 MR. TURK: But the witness stated he
22 doesn't know if this is a controlling fault. And
23 that's why I asked the question. I'm not sure what
24 we establish with this exhibit. I have no problem
25 if the State wants to examine Dr. Arabasz on his

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1 own work. But I don't know what this exhibit
2 establishes. I don't see what it's relevant to. I
3 don't see how reliable it is without going --

4 JUDGE FARRAR: Let's see if the
5 question -- why don't you keep your objection at
6 hand and we'll see where the questioning goes, and
7 you can state the objection at the appropriate
8 time.

9 Q. (By Ms. Chancellor) Dr. Arabasz, do you
10 personally know Dr. Ivan Wong?

11 A. Yes, I do.

12 Q. And is he the project manager for --
13 what is his position?

14 A. He was the project manager for the
15 probabilistic analysis undertaken for the
16 Department of Energy by the USGS and by URS
17 Corporation in a management role for overseeing the
18 expert elicitation for vibratory fault -- excuse
19 me -- for vibratory seismic hazard analysis and
20 fault displacement hazard analysis at Yucca
21 Mountain.

22 Q. And was the purpose of your
23 communication with Dr. Wong, was the purpose to
24 obtain information that was not available to you
25 elsewhere?

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1 A. Correct.

2 Q. And could you explain your confidence in
3 the information that you obtained from Dr. Wong?

4 A. I'm smiling because Dr. Wong as of late
5 happens to be a Ph.D. student in our department for
6 whom I'm an advisor.

7 Q. He's not in the room, Dr. Wong.

8 A. I can I think deal with the Yucca
9 Mountain information in another way without relying
10 on these hazard curves. As represented, the answer
11 would be that the exceedance probabilities would be
12 in the order of 2 times 10 to the minus 5.

13 If I go back to two things. If I were
14 to return to State's Exhibit 203, the Kennedy and
15 Short table, with my annotation of curve for --
16 excuse me -- my annotation of the A sub R values
17 for Yucca Mountain and compare the slope of 2.40 at
18 Yucca Mountain with 2.29 for Palo Verde which has
19 an exceedance probability of approximately 26,000
20 years, the bottom line is that one would get an
21 exceedance probability greater than 10,000 years,
22 of the order of tens of thousands of years.

23 And I believe that with earlier PSHA
24 results, DOE may have been aware of this when it
25 undertook the Yucca Mountain topical report to

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1 exercise, had the statistics in front of them for,
2 quote, these nuclear power plants in the western
3 United States but chose not to use as a benchmark
4 5,000 years but 10,000 years.

5 Q. And finally, to fill in the details of
6 the western United States, if you would turn to
7 State's Exhibit 206, Seismic Hazards Evaluation of
8 the Los Alamos National Laboratory dated 24
9 February 1995, the cover page with second page
10 Figure 8-9 and Figure 9-98.

11 Are you familiar with this report,
12 Dr. Arabasz?

13 A. Yes, I am.

14 Q. And what was the purpose of going to or
15 looking -- did you need Figure 8-9 and Figure 9-98
16 and State's Exhibit 206 to do your qualitative
17 fill-in, if you will, of sites in the western
18 United States with respect to hazards?

19 A. First, I would have observed, as I did
20 earlier in my May 17 testimony, that in the -- in
21 DOE Standard 1020-2002, Table C-3, that Los Alamos
22 was clearly a Department of Energy site and did
23 not, to appearances, have characteristics that
24 would achieve a risk reduction ratio that would put
25 it into that special class of facilities such as

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1 LLNL, SNL-Livermore, SLAC and so on, the DOE
2 facilities near the tectonic plate boundaries.

3 I'm missing a piece of paper. Excuse
4 me.

5 Q. Should I send Ms. Braxton over there to
6 keep you organized, Mr. Arabasz?

7 MR. TURK: See if she can stop at my
8 desk on the way over.

9 A. Okay, then I would have noted in the
10 Kennedy and Short Table A2, State's Exhibit 203,
11 that the LANL site was in the category of western
12 DOE sites not near the tectonic plate boundary,
13 again consistent with not assigning it a 5,000-year
14 P sub H value but maintain the 10,000-year hazard
15 exceedance value.

16 I happened to have available to me this
17 Los Alamos report as a member of the Seismic
18 Laboratory Review Committee, so I went to the
19 report and excerpted two representative figures,
20 the first one labeled TA-55, meeting empirical
21 acceleration response spectra for Pajarito Fault,
22 P-a-j-a-r-i-t-o, and M sub W 7 earthquake. And the
23 M, magnitude 7 earthquake on the Pajarito Fault is
24 the controlling deterministic motion.

25 Note that the solid curve is the average

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1 P GA. At .5 g, and this is an average for
2 empirical motions using the attenuation relations
3 described below, in the report it's clear that
4 these empirical ground motions are lower than the
5 theoretical response motions, and so I knew that
6 these results were conservative.

7 And further, the values plotted here are
8 median deterministic motions, not 84th percentile.
9 And so I was aware of that. And TA-55 being one of
10 the representative technical areas on the Los
11 Alamos compound.

12 If I enter the curve on -- the solid
13 curve on Figure 8-9 at .1 seconds for 10 Hz and .2
14 seconds for 5 Hz and then compare with the median
15 equal hazard spectra in Figure 9-98 from the PSHA
16 results, I observe qualitatively that those values
17 are approaching 10,000 years, let me say in general
18 of the order of several thousand years.

19 Q. So for the Yucca Mountain site, the INEL
20 site, the PFS site and the Los Alamos site, the
21 tour that we have just done, do you feel that this
22 gives you sufficient information to say that
23 5,000-year ground motions from a mean return period
24 earthquake for 5,000 years should not be used if a
25 nuclear power plant were to be cited at any of

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1 these sites?

2 MR. TURK: Any of which sites?

3 MS. CHANCELLOR: Yucca Mountain, INEL,
4 PFS, Los Alamos.

5 A. I will try to answer this way, that I
6 would not believe that the reference probability
7 for a hypothetical new nuclear power plant in the
8 western United States would appropriately be pegged
9 at 5,000-year return period ground motion. And
10 from my walk-about through the western United
11 States, once I've left the plate boundary, when
12 I've moved eastward to Hanford, when I've moved
13 eastward to Palo Verde, farther eastward to Yucca
14 Mountain, to INEL to the PFS site and to Los
15 Alamos, from the aggregate information before me I
16 guess I finally have information to respond to
17 Mr. Gaukler's questioning, which would be my
18 judgment that the benchmark for nuclear power plant
19 against which to compare relatively a ground motion
20 value for an ISFSI, the benchmark would be in the
21 order of 1 times 10 to the minus 4.

22 MS. CHANCELLOR: Your Honor, I would
23 move for admission of State's Exhibit 203, which is
24 the Kennedy and Short paper; 205, the Geomatrix --
25 the exhibit that comes from Geomatrix; and 206, the

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1 information with respect to Los Alamos Laboratory.
2 And I will not move for entry of 205 which Mr. Turk
3 opposed to.

4 JUDGE FARRAR: I must have misheard you.
5 You said you're moving --

6 MS. CHANCELLOR: 203, 204, and 206 but
7 not 205.

8 JUDGE FARRAR: Any objection to 203?

9 MR. GAUKLER: No objection.

10 MR. TURK: None from the Staff, your
11 Honor.

12 JUDGE FARRAR: Okay, then 203 will be
13 admitted.

14 (STATE'S EXHIBIT 203 WAS ADMITTED.)

15 JUDGE FARRAR: 204?

16 MR. GAUKLER: None.

17 MR. TURK: I have no objection on 204.

18 JUDGE FARRAR: All right, then 204 will
19 be admitted.

20 (STATE'S EXHIBIT 204 WAS ADMITTED.)

21 MR. TURK: If I'm correct, that's --
22 yes, Geomatrix.

23 JUDGE FARRAR: Stone & Webster,
24 Geomatrix. And then 206, the Los Alamos document.

25 MR. TURK: I object to this one, your

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1 Honor. Should I wait for the Applicant?

2 JUDGE FARRAR: No, go ahead. On what
3 ground?

4 MR. TURK: On grounds of relevance.
5 Dr. Arabasz indicated in his statement that he was
6 aware that these are -- may I have a moment?

7 JUDGE FARRAR: Yes.

8 Mr. Gaukler, while they're thinking,
9 what's your position?

10 MR. GAUKLER: No objection.

11 JUDGE FARRAR: No objection.

12 MR. TURK: Your Honor, based on the fact
13 that this is a document that Dr. Arabasz referred
14 to in attempting to establish a pertinent value for
15 the Los Alamos site, I do not object to the
16 introduction of the exhibit. I will, however, have
17 questions for him.

18 JUDGE FARRAR: All right, then 206 will
19 be admitted.

20 (STATE'S EXHIBIT 206 WAS ADMITTED.)

21 JUDGE FARRAR: And Ms. Chancellor, you
22 said you were not offering 205?

23 MS. CHANCELLOR: It's not worth going
24 through the argument, your Honor. We won't move
25 for entry of 205.

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1 MR. TURK: May we go off the record?

2 JUDGE FARRAR: No, because I'm debating
3 what to say about Ms. Chancellor's answer, because
4 if the evidence is valuable then it is worth going
5 through the argument, because --

6 MS. CHANCELLOR: Your Honor, rather than
7 belabor the hearings, Dr. Arabasz moved to a
8 different set of information, and let me just ask
9 Dr. Arabasz a question.

10 Q. (By Ms. Chancellor) Dr. Arabasz, did
11 the information that you relied on in the Kennedy
12 and Short paper, did that inform you with respect
13 to the Yucca Mountain site as to the reference
14 probability for a --

15 A. Yes, it did. And similarly I would add
16 for the Los Alamos site that using the Kennedy and
17 Short paper I can arrive at my conclusion that the
18 hazard curves at those sites do not result in risk
19 reduction ratios that warrant, in the DOE frame
20 work, a reduction from a 10,000-year to a
21 5,000-year value.

22 MS. CHANCELLOR: On that basis, your
23 Honor, there's no need for the State to move for
24 admission of 206.

25 JUDGE FARRAR: All right. Then thank

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1 you for that.

2 MR. TURK: 205.

3 MS. CHANCELLOR: 205. Thank you.

4 JUDGE FARRAR: Thank you for that
5 additional clarification. Mr. Turk, I think you
6 wanted to go off the record.

7 MR. TURK: If I can, your Honor, just
8 for a few minutes.

9 (Discussion off the record.)

10 JUDGE FARRAR: Back on the record.

11 Q. (By Ms. Chancellor) Dr. Arabasz, you
12 may recall a discussion yesterday with respect to
13 the Martinez paper, and Mr. Turk had you refer to
14 NRC Exhibit PP on page 18 in which there was a
15 discussion about the Martinez paper used by the
16 Staff to support a slip rate of nearly ten times
17 larger -- that the Wasatch fault has a slip rate
18 nearly ten times larger than the Stansbury fault.
19 Do you recall that line of questioning?

20 A. Yes, I do.

21 Q. What problem do you have with the Staff
22 using the Martinez paper to argue that the PSHA at
23 the PFS site is conservative?

24 A. With more time referring to the paper, I
25 returned to it and I have my own copy. I don't

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1 have the exhibit number identified.

2 Q. That's fine.

3 A. I would like to read from the paper, but
4 presumably you need the exhibit reference.

5 MR. TURK: May we have just a moment?

6 MS. CHANCELLOR: State's Exhibit 184.

7 MR. TURK: Yes.

8 A. Referring to the abstract, the left
9 column on page 567, and approximately two thirds of
10 the way down through the abstract there's a
11 sentence that begins, "While we do not yet know the
12 source of this unexpected contemporary
13 deformation," namely the increased deformation
14 observed by GPS, the text continues, "loading of
15 the" -- excuse me. I guess I've confounded the
16 recorder, probably, by not reading verbatim. Let
17 me begin again and I'll read it verbatim.

18 "While we do not yet know the source of
19 this unexpected contemporary deformation, possible
20 mechanisms include homogeneous crustal extension,
21 loading of the Wasatch and adjacent faults, and
22 pressure solution creep." In other words, the
23 interpretation of the observation was uncertain.
24 One possible modeling interpretation is that the
25 deformation was reflecting higher slip on the

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1 Wasatch fault, but there were other interpretations
2 that the authors were considering.

3 On page 569, right-hand column in the
4 section Implications of High Strain Rates, the
5 second paragraph reads, "To examine possible
6 sources of the GPS measured horizontal deformation
7 field, Martinez [1996] constructed simple
8 dislocation models for plausible geometries of the
9 Wasatch and nearby faults similar to those of
10 Savage et al. [1992]. Within the observed
11 measurement uncertainties the results were found to
12 be consistent with 1) approximately 4 to 5
13 millimeters per year of localized slip on a varied
14 fault plane tipping 60 degrees west, or 2) uniform
15 east-west straight of a homogeneous crustal block.
16 It is not yet possible to distinguish between these
17 two end member models because of a lack of broader
18 GPS coverage and the limitations of the current
19 resolution of the GPS measurements."

20 In other words, the interpretation
21 remains uncertain as to what the cause of those
22 observed high strain rates are.

23 Q. And in the Martinez paper, did they use
24 the same methodology in comparing slip rates on the
25 Wasatch and Stansbury faults?

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1 A. No. We visited this earlier in my
2 testimony that one had information on geodetic
3 deformation rates from GPS measurements in the
4 vicinity of the Wasatch fault. One had geological
5 slip rate information, namely, information on
6 displaced geological horizons of known or estimated
7 age where one estimated the slip rate from the
8 displacement divided by the time interval. And so
9 we have a comparison of geological slip rate
10 information on the Wasatch, geological slip rate
11 information on the Stansbury fault, GPS information
12 in the vicinity of the Wasatch fault, no comparable
13 GPS information in the vicinity of the Stansbury
14 fault.

15 Q. And do you consider it acceptable to do
16 a comparison using different methodologies?

17 A. If this were a rigorous PSH exercise
18 with let's say a multiteam approach, it might be
19 attempted. It would be subject to lots of
20 criticism and, in my view, it probably would be
21 beaten down.

22 Q. Thank you. Finally, Dr. Arabasz, I'd
23 like you to turn to State's Exhibit 209. This is
24 first page Safety Evaluation Report for systems not
25 directly associated with storage pads of Private

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1 Fuel Storage facility, December 15, 1999. Do you
2 have that document?

3 A. I have it in front of me. Thank you.

4 Q. If you'd take a moment to review --

5 MR. TURK: May we take just a moment,
6 please? This is State Exhibit --

7 MS. CHANCELLOR: 209. It was handed out
8 yesterday, Mr. Turk.

9 MR. TURK: We've located it.

10 MS. CHANCELLOR: Do you need some more
11 time, Mr. Turk?

12 MR. TURK: Turk 207?

13 MS. CHANCELLOR: 209.

14 MR. TURK: Just a minute. Okay.

15 Q. (By Ms. Chancellor) Dr. Arabasz, are
16 you familiar with this document?

17 A. Yes, I am.

18 Q. And does this document, State's Exhibit
19 209, contain bullets from -- the first three pages,
20 does that contain bullets from various versions of
21 the Staff's Safety Evaluation Reports?

22 A. Correct, with the observation that the
23 fifth and fourth page includes bullets from the
24 Modified Rulemaking Plan SECY-01-078.

25 Q. You anticipated may my next question.

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1 Thank you. And with respect to Utah Contention L
2 Part B, which is now Utah L/QQ part E, you
3 testified yesterday, I believe it was, that if we
4 are to track your testimony or your involvement in
5 this, you need to track the staff. Do these
6 five -- by that testimony do you mean that you
7 track the bullets in the SER that the Staff has
8 given for the rationale at various stages for
9 considering and determining the use of a 2,000-year
10 return value at the PFS site?

11 A. Basically, yes, that the process has
12 been evolutionary. We've heard that the Staff's
13 thinking has been evolutionary, and I explained
14 earlier that I'm either cursed or blessed with a
15 need to see the big picture, and this provided a
16 convenient road map for me and I believe for others
17 to put side by side the bases for justifying the
18 2,000-year return period and to examine them.

19 Q. Now, I don't want to beat that horse too
20 much, but could you just briefly review the Safety
21 Evaluation Report for December of the excerpts from
22 December 15, 1999 and then proceed on to the
23 September 2000 and March 2000 consolidated SER and
24 explain how certain items have been carried through
25 and others may not have?

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1 JUDGE FARRAR: Before you do that,
2 Dr. Arabasz, everyone may be able to focus better
3 on what I think will be a lengthy answer if we take
4 a break first.

5 MS. CHANCELLOR: That's fine, your
6 Honor. This -- I would just note that this is the
7 last portion of my redirect.

8 JUDGE FARRAR: But this will be a fairly
9 long answer, I assume?

10 MS. CHANCELLOR: I assume it will.

11 MR. TURK: And your Honor, when you hear
12 the answer, before you do that I'd like to object
13 to the exhibit and to the examination on it and the
14 question, and I'll wait until after the break if
15 you'd like.

16 MS. CHANCELLOR: Then we definitely need
17 a break, your Honor.

18 JUDGE FARRAR: I think we're going to
19 change reporters at the same time. Let's come back
20 at five after.

21 (A recess was taken.)

22 JUDGE FARRAR: I think we're ready to
23 resume. When we left off, Ms. Chancellor, I think
24 you were about to ask the witness -- did you
25 already ask him about Exhibit 209?

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1 MS. CHANCELLOR: I believe I was
2 starting there, your Honor, and because the
3 response may be a little lengthy you decided to
4 take a break.

5 JUDGE FARRAR: Had you asked the
6 question --

7 MS. CHANCELLOR: I can -- we can start
8 from scratch, your Honor.

9 JUDGE FARRAR: Yes, go ahead.

10 Q. (By Ms. Chancellor) Dr. Arabasz, you
11 have spoken about a logic train. And would it help
12 us take an excursion on that logic train if you had
13 the various bullets of the Staff's evolving and
14 changing -- well, I won't characterize it -- the
15 Staff's various rationale as described in the SAR
16 version that came out on December 15, '99, the
17 SAR --

18 MR. GAUKLER: You mean SER?

19 MS. CHANCELLOR: I beg your pardon, Mr.
20 Gaukler. I didn't mean to ascribe that to PFS.

21 Q. (By Ms. Chancellor) Start again. The
22 first page, the SER from December 15, 1999, the SER
23 from September 29, 2000, the Consolidated SER of
24 March 2002, and the Modified Rulemaking Plan of
25 September 2001. Having the excerpts from these

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1 four documents in front of you, would that help
2 succinctly describe the logic train that you have
3 been talking about with respect to the big picture
4 overview of your concerns with the State's -- with
5 the Staff's logic?

6 A. Yes, it would.

7 Q. And could you succinctly go through the
8 four pages that form State's Exhibit 209 and help
9 us with this logic train?

10 MR. TURK: Objection.

11 JUDGE FARRAR: On what ground?

12 MR. TURK: The staff has already
13 introduced into evidence each of the documents
14 which contain the bullets. We have examined Dr.
15 Arabasz on each of those documents. If you'll
16 recall, Staff Exhibit A was the preliminary SER of
17 1999, Staff Exhibit NN is the September 2000 SER,
18 Staff Exhibit OO and PP contain the SER Supplement
19 No. 2 either in unbracketed or bracketed form
20 showing the differences between that document and
21 the September 2000 document. That is already in
22 the record. Dr. Arabasz's testimony explains the
23 logic train that he followed and his concern about
24 the moving target presented by the Staff and PFS.
25 The information is already on the record.

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1 My objection as to examination on
2 Exhibit 209 and on the introduction of 209, because
3 if it's correct that it is a recitation of what is
4 in the other documents then it's duplicative. And,
5 frankly, I would have to look at it to assure
6 myself that it is, in fact, a correct replication
7 of what is in those documents. That's my first
8 objection.

9 My second objection is that the bullets
10 are out of context. They appeared in Section
11 2.1.6.2 of the various SERs and the context is the
12 entire section of the SER. What we're presented
13 with here, assuming that Mr. Chancellor has
14 accurately replicated them, is something taken out
15 of those documents which are in the record already
16 and it's out of context.

17 And finally with respect to the fourth
18 page of this proposed Exhibit, that document is
19 also in evidence. Ms. Chancellor represents or Dr.
20 Arabasz represents that this is a portion of
21 SECY-01-178, which is the Modified Rulemaking Plan.
22 That is in evidence as a Staff Exhibit also.

23 JUDGE FARRAR: Mr. Gaukler?

24 MR. GAUKLER: I have no objection.

25 MR. TURK: For the record, let me note

1 that the last page is, if it is a correct
2 replication, it's a portion of Staff Exhibit U.

3 MS. CHANCELLOR: Your Honor, I would
4 request that I be permitted to examine the witness
5 on this Exhibit. It has not yet been offered. It
6 has been marked, but it has not yet been offered to
7 be introduced. I would request that I be permitted
8 to examine the witness.

9 JUDGE FARRAR: Give us a moment here.

10 (The Board confers off the record.)

11 JUDGE FARRAR: Recognizing that State
12 209 for identification does not appear to be a
13 photocopy of the SERs, nonetheless, Mr. Turk, we
14 allowed you to cross-examine the witness and track
15 his chain of logic as he took into account or
16 didn't take into account changes in the Staff
17 thinking, and there is no reason not to allow the
18 State to, in response to your examination, to take
19 him through the Staff's thinking which, after all,
20 is at the heart of this case in whatever way they
21 see fit.

22 You, of course, will be welcome, if it
23 turns out this is not an accurate copy or
24 recitation of what's in the document, or if there's
25 context in the four documents that needs to be

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1 brought to bear, you'll have your opportunity to do
2 so. So the objection is overruled. Go ahead, Ms.
3 Chancellor.

4 MS. CHANCELLOR: Thank you, your Honor.

5 Q. (By Ms. Chancellor) Dr. Arabasz, is the
6 train ready to leave the station?

7 A. Almost. One moment, Ms. Chancellor.

8 MR. TURK: May we ask, then, for
9 representation from counsel for the State that this
10 is, in fact, a correct replication of the portions
11 of those Exhibits that I mentioned?

12 JUDGE FARRAR: This was keystroked in by
13 your people from the documents? How was it
14 prepared?

15 MS. CHANCELLOR: I had a discussion with
16 Mr. Turk during the break to see if I could satisfy
17 him. It was electronically copied from the SER and
18 pasted onto a separate page and each page is a
19 electronic representation of what appears in what
20 was given to us for the various SERs and Modified
21 Rulemaking Plan.

22 JUDGE FARRAR: So there's not the danger
23 of keystroke error?

24 MS. CHANCELLOR: To the best of my
25 knowledge, no, your Honor.

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1 MR. LAM: Also, there was no
2 modification to this bullet by you?

3 MS. CHANCELLOR: Absolutely no
4 modification. It was just basically copy/paste
5 from an electronic version to get everything in a
6 succinct format in one place. But no, it was
7 electronically done.

8 JUDGE FARRAR: Then in response to Mr.
9 Turk's request for a proper representation of the
10 legitimacy of this version, you can make that, you
11 can make that representation?

12 MS. CHANCELLOR: I certainly can, your
13 Honor.

14 JUDGE FARRAR: Then let's go ahead.

15 Q. (By Ms. Chancellor) Dr. Arabasz, I
16 believe you testified that you reviewed the various
17 versions of the SER, but you focused on the bullets
18 with respect to analyzing the Staff's logic for
19 considering and recommending the 2,000-year return
20 period for the exemption proposed; is that correct?

21 A. Correct.

22 Q. And with the documents -- with the
23 various pages side by side, could you take us
24 through the overline rationale that the staff used
25 and how that changed?

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1 A. Yes. This can simply be done I think
2 with some pattern recognition, just standing back
3 from these documents and being able to view the
4 bullets side by side.

5 On the first page, and I believe I've
6 put my ripped up pages in order here, I'm looking
7 at the Safety Evaluation Report, or an excerpt from
8 it dated December 15, 1999. In the first bullet,
9 generally we see the reference to DOE-STD-1020 as a
10 point of reference, namely, the 2,000-year return
11 period for a performance Category-3 facility.

12 In the second bullet we see reference to
13 the Uniform Building Code and a total probability
14 of exceedance, which we've learned has fallen by
15 the wayside in the Staff's thinking, except to the
16 extent that it reappears in the Modified Rulemaking
17 Plan.

18 In the third bullet we see the reference
19 to the TMI ISFSI, and I've explained in my view
20 that what was approved was a design basis ground
21 motion in fact higher than a 2,000-year value. But
22 I think the key point in this bullet is to
23 recognize that what was central to the -- one of
24 the things that was central to the request was that
25 it was a DOE facility, which had DOE standards to

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1 consider or to enter into consideration and,
2 namely, the DOE 1020 Standard of a 2,000-year
3 ground motion for a PC-3 facility.

4 The fourth bullet, ancient history.
5 What was challenged to be circular reasoning,
6 referring to what Geomatrix thought was appropriate
7 and examination of the Geomatrix reasoning,
8 referring back to Staff reasoning, and that fell by
9 the wayside and became ancient history.

10 As we advance in time to the second
11 page, September 29, 2000, what I see in terms of
12 pattern recognition is the first three bullets are
13 part of establishing a proposition, namely, that
14 the radiological hazard of a dry cask ISFSI less
15 than a nuclear power plant. The second bullet
16 getting into the median versus mean issue, and then
17 ending up with the third bullet which is the
18 statement that, "On the basis of the foregoing, the
19 mean annual probability of exceedance for the PFS
20 Facility may be less than 10 to the minus 4 per
21 year."

22 From my testimony earlier this morning,
23 one can fairly say that even though I disagree with
24 how the Staff may have gotten there, namely, that
25 median versus mean issue, on the third bullet we're

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1 basically of the same view.

2 Then the two bottom bullets, again the
3 reference to the DOE-STD-1020 for PC-3 and the
4 TMI-2. I'll note that on each of these pages,
5 perhaps I should have done so at the beginning, I
6 think the introductory sentence is the same in all
7 cases, and it reads, "However, the staff has
8 determined that a 2,000-return value with the PSHA
9 methodology can be acceptable for the following
10 reasons."

11 So so far what we see tracking
12 consistently in time is the reliance on the
13 DOE-STD-1020 and the reliance on the precedent of
14 the TMI to ISFSI exemption. Then when we come to
15 the most recent Consolidated SER, the third page of
16 this Exhibit, an excerpt from the March 2002 Safety
17 Evaluation Report, we again see the first three
18 bullets developing that proposition that on the
19 basis of the foregoing, the mean annual probability
20 of exceedance for the PFS facility may be defined
21 greater than 10 to the minus 4 per year, and we see
22 continuing to appear consistently the reference to
23 the DOE-STD-1020, and the TMI-2 precedent.

24 The fourth page, the Modified Rulemaking
25 Plan, I don't need to concern myself with greatly

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1 at this point. I'll simply observe that the first
2 bullet is the TMI-2 precedent; the second one, this
3 issue of consideration of the total probability of
4 exceedance as a measure of acceptable risk, and we
5 heard from Mr. Turk that the staff may re-examine
6 whether it chooses to maintain that argument.

7 And then the bullet at the bottom, the
8 reference again to the DOE-STD-1020 and the mean
9 annual probability of exceedance of 5×10^{-4} to the
10 minus 4 for the 2,000-year ground motion. So that
11 as the train arrives at this hearing in its most
12 updated version, namely, the Consolidated Safety
13 Evaluation Report, what I understand to be the key
14 underpinnings of the Staff's justification for the
15 2,000-year return value comes down to the first
16 three bullets that developed the proposition,
17 again, that relative to a benchmark of 10^{-4} to the
18 minus 4 per year for a nuclear power plant, a PFS
19 facility could have a hazard probability that were
20 higher, a mean return period ground motion that
21 were lower.

22 And then in the last two bullets it
23 seems to me that ultimately the Staff comes down to
24 reliance on the DOE-STD-1020, either explicitly in
25 the third bullet or implicitly in the TMI-2

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1 exemption precedent.

2 Now, if that's the case, we come back to
3 what I think is good news, that the Staff, if it
4 chooses to stay pinned on the 2,000-year value,
5 while 2002 -- excuse me, while DOE-STD-1020 has
6 moved on to a exceedance probability of 2500 years
7 for PC-3, it can only stay pinned on that
8 2,000-year value if it accepts the target size and
9 performance goal of 1 times 10 to the minus 4.

10 And I think that's good news because I
11 believe that this logic is forcing finally some
12 kind of fixed star to navigate by, that the Staff,
13 I've been told, need not accept the DOE-STD-1020,
14 but it's such a key point that one has to somewhere
15 accept a seismic performance goal to move on to the
16 rest of the logic to consider a hazard probability
17 and risk consistency.

18 This equation that I showed you this
19 morning about $R \text{ sub } R \text{ equals } PH \text{ over } P \text{ of } F$, this
20 appears in that reference B4 in the Reg Guide 1.165
21 as to how to consider a reference probability
22 different than 1 times 10 to the minus 5 median.
23 The design approach and philosophy was developed in
24 the reference document in DOE-STD-1020 and its
25 various versions. Again, a standard design

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1 approach and philosophy was developed. It was
2 developed in the Kennedy and Short paper as a basis
3 for DOE-STD-1020 and I'm greatly impressed by
4 looking at NUREG 6728 or NUREG/CR 6728, and if I
5 could just pick that up for a moment, Section 7,
6 the NUREG is titled Technical Basis for Revision of
7 Regulatory Guidance on Design Ground Motions:
8 Hazard and Risk Consistent Ground Motion Spectra
9 Guidelines. And Section 7 specifically is titled
10 Procedure for the Development of Risk Consistent
11 Spectra.

12 Let me read a sentence from the
13 beginning of the introduction section of Section 7
14 of the cited NUREG. "For the purposes of this
15 project we mean by consistency that the ground
16 motion recommendations result in facilities at
17 different sites having about the same level of
18 safety from earthquake caused failures no matter
19 where there (sic) are located in the country."

20 So I guess as I try to figure out how to
21 get off the train and when I can, I think that the
22 discussion put forward by Professor Cornell in
23 Attachment A of his prefiled testimony basically
24 lays out a rational framework for deciding how to
25 deal with the reference probability.

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1 He, I think, is constrained to some
2 extent by needing to argue within the DOE, what I
3 call the DOE paradigm or the DOE framework. In
4 other words, considering a seismic performance
5 goal, a hazard probability and then with the risk
6 reduction ratio consider the conservatisms that are
7 achieved in the design procedures and the
8 acceptance criteria.

9 I have made it plain in my prefiled
10 testimony that I agree with this need to
11 fundamentally couple the hazard exceedance
12 probability with the design side and that if one
13 accepts this proposition that sufficient protection
14 depends on that fundamental coupling, then I've
15 gone as far as I can on the train and have to pass
16 off to the engineers and for the Board to consider
17 whether, as Dr. Cornell argues, those
18 conservatisms, indeed, have been achieved on the
19 design side to justify the 2,000-year return
20 period.

21 And if a judgment is made that they have
22 not or there's uncertainty whether they have then
23 one would come back to something like State's
24 Exhibit 208 where I have the graph at the bottom of
25 the table and we have the famous left-hand and

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1 right-hand, if that sufficient protection isn't
2 achieved on the design side, then necessarily it
3 requires that left-hand side to come up with the
4 return period of the ground motion.

5 MS. CHANCELLOR: Thank you, Dr. Arabasz.
6 I have no further questions.

7 Oh, your Honor, I do have one thing. I
8 would like to move for entry of State's Exhibit
9 209.

10 JUDGE FARRAR: Mr. Gaukler?

11 MR. GAUKLER: No objection.

12 JUDGE FARRAR: Mr. Turk?

13 MR. TURK: Your Honor, I noted my
14 objection previously. I would restate it, but
15 expect your ruling to be adverse.

16 JUDGE FARRAR: Unless you have something
17 additional to add, you're correct.

18 MR. TURK: I think the only thing I
19 would make clear, your Honor, is that the bullets
20 are taken out of context. In each case the State
21 left off the concluding paragraph as well as all
22 the preceding discussion that led up to those
23 bullets. This may be significant and I think that
24 any time one looks at this Exhibit one must keep in
25 mind that more was said by the Staff than the State

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1 is representing here because they have taken the
2 bullets out of context. And, for example, if I may
3 just note what I mean by that --

4 JUDGE FARRAR: Rather than have you note
5 it, number one, your complete version of the
6 document will indicate that, and you, of course,
7 would be free to put on a Staff witness who could,
8 I assume, fairly briefly point out that something
9 has been omitted that would be appropriate to put
10 the matters in context. So on that basis we will
11 admit State Exhibit 209.

12 MS. CHANCELLOR: Thank you, your Honor.

13 (STATE'S EXHIBIT-209 ADMITTED.)

14 JUDGE FARRAR: Mr. Gaukler, do you have
15 some -- I think you had indicated yesterday you had
16 some cross.

17 MR. GAUKLER: Yes. Should I start?

18 JUDGE FARRAR: Yes, go ahead.

19

20 CROSS-EXAMINATION

21 BY MR. GAUKLER:

22 Q. Good morning, Dr. Arabasz.

23 A. Good morning, Mr. Gaukler.

24 Q. I will agree with you, it has been a
25 long train ride.

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1 If you recall back to May 17 when you
2 were testifying here before, Judge Lam and Judge
3 Farrar asked you to arrive at what you would
4 consider an appropriate earthquake level assuming
5 you disregarded any conservatism in the design. Do
6 you remember that?

7 A. Yes, I do.

8 Q. And you were very reluctant to go that
9 route because, as you've stated in your testimony
10 and have just reiterated, you believe you should
11 consider both the mean annual probability of
12 exceedance of an earthquake as well as whatever
13 conservatisms may be inherent in the design
14 procedures and criteria for the structure, correct?

15 A. Correct.

16 Q. And, in fact, that is the whole purpose
17 of your State Exhibit 208, to show the relationship
18 as far as you see it being an appropriate
19 relationship as far as you see it, correct?

20 A. Correct.

21 Q. Now, in response to Judge Lam's or Judge
22 Farrar's question, I forget whose it was at the
23 specific point in time, to disregard any
24 conservatism you considered the possibility of an
25 earthquake longer than a 2,000-year earthquake and

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1 you concluded perhaps that a figure of 4,000,
2 excluding any conservatism, might be an appropriate
3 figure.

4 A. I recall that, yes.

5 Q. Now, that was just a number that did not
6 take into account any conservatism in the design of
7 the structure or anything like that, correct?

8 A. Correct.

9 Q. And assuming, hypothetically, one were
10 comfortable with a three or 4,000-year earthquake
11 which would equate in that situation to really the
12 performance goal, correct?

13 A. Let's see. Let me use my cheat sheet,
14 if I may. The performance goal is 1 times 10 to
15 the minus 4.

16 Q. What?

17 A. The performance goal for a PC-3 is 1
18 times 10 to the minus 4.

19 Q. I guess I was assuming hypothetically if
20 one took 4,000 years with no conservatism, being
21 satisfied with that, with an R sub R of 1, your
22 4,000 years was?

23 A. That would be an R sub R between 2 and
24 3.

25 Q. Okay. I have --

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1 A. Referring, if you choose to, to keep
2 either of us from tripping up, if you choose to
3 refer to State Exhibit 208, and so that in the
4 left-hand column, looking at where a 4,000-year
5 ground motion would fall, and you would see that
6 would fall between the 2 and the 3 R sub R.

7 Q. So if you were to take conservatism into
8 account, then you would come up with a 4,000-year
9 with the conservatism of R factor of 2.5 to come up
10 to a performance goal of 10,000 is what you just
11 stated right now, correct? Is that correct?

12 A. I'm sorry, I'm getting confused.

13 Q. I am too. I guess I was trying to go
14 back to hypothetically where you didn't consider
15 any conservatism, okay? And you just picked the
16 figure of 4,000.

17 A. Would it help you if I explained or
18 tried to justify how I honed in on that 4,000-year
19 number?

20 Q. That might help focus us, yeah.

21 A. If I were in a situation where the
22 engineers were in another room discussing the
23 conservatism and I either didn't know what their
24 outcome would be or someone exited the room and
25 said, "We don't know," what I would turn to is a

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1 different framework for judging acceptable risk,
2 and that framework would be a probability of
3 exceedance.

4 And in my mind this might be comparable
5 to how the NRC thinks about on a capacity curve, as
6 I understand it, the high confidence low
7 probability of failure point, the 1 percent
8 probability of exceedance. And I would look at --
9 I would consider the 40-year lifetime of the
10 facility a 1 percent probability of exceedance,
11 which was a value of 3980 years, or approximately
12 4,000 years. So forced into that question, that's
13 how I come back and respond.

14 Q. So basically you were looking at the
15 life of the facility in that context then?

16 A. That, and as I discussed -- or I believe
17 I described to Judge Lam, the relative return
18 period for large earthquakes on the Stansbury fault
19 to get me closer to a level of comfort about
20 adequately conservative, sufficient and protective.

21 Q. So, again, that testimony was all tied
22 into the assumption of the hypothetical you were
23 working with excluding any consideration of
24 conservatism in the design in picking the level of
25 earthquake, design basis earthquake, correct?

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1 A. That's correct.

2 Q. And then going back to what you believe
3 is the appropriate method, you would go back to
4 your table which is Exhibit 208, correct?

5 A. Within the context here as appropriate.
6 If you asked me -- well, I guess it would be an
7 either here nor there because I would have in front
8 of me the DOE paradigm and I would also have in
9 front of me the NUREG 6728 framework. And I think
10 it's evident that there are directions to be
11 considered in regulatory decision making in 6728
12 that might be better, but here I think in this
13 hearing the DOE 1020 framework is where we are.

14 Q. So just going back to this DOE 1020
15 framework, if Dr. Cornell is hypothetically correct
16 that we have a risk reduction factor in the order
17 of 5, then that would justify in your mind the
18 2,000-year return basis earthquake, correct?

19 A. I've stated that, yes. That's where the
20 logic train takes me and I have committed to that.

21 Q. Also, just on the logic train --

22 A. I'm sorry, there's one qualifier, and
23 that's the acceptance of the performance goal, the
24 1 times 10 to the minus 4.

25 Q. But the risk if you had a 2,000-year --

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1 and you would agree that's an appropriate
2 performance goal for an ISFSI of this sort?

3 A. Yes. We discussed this issue last
4 October in my deposition and I agreed that 1 times
5 10 to the minus 4 performance goal I considered
6 appropriate for the PFS facility.

7 Q. Going back to the logic, do you have the
8 letters that Mr. Turk went over with you? These
9 were your reports to the State's Attorney General
10 Office with respect to the --

11 A. Yes, I do.

12 Q. -- with respect to the PSHA and the
13 exemption? And you recall that both Mr. Turk
14 questioned you and then Ms. Chancellor followed up.
15 I would like to have you look at the third page
16 from the back, which is page 2, it's in the second
17 document we were talking about, which is Issues and
18 Perspectives Relating to Hazard Assessment of
19 Earthquake Ground Shaking and Surface Fault
20 Displacement for Licensing the Private Fuel Storage
21 Facility in Skull Valley Utah.

22 A. On the third page?

23 Q. It's page 2.

24 A. It's labeled page 2, correct.

25 Q. And that's where we're talking about --

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1 where we have stated here that, "If, indeed, the
2 dry storage cask and canisters, even under the
3 conditions of a major seismic event, are as safe as
4 asserted by PFS and believed by NRC staff, then we
5 can think of no compelling argument to put forward
6 against awarding the exemption." Do you see that?

7 A. Yes, I do.

8 Q. And basically, I take it, what you're
9 referring to in terms of the cask and canisters
10 being as safe as asserted by PFS was the assertion
11 by PFS that the, number one, that the cask would
12 not tip over and, number 2, even assuming they
13 would tip over there would be no release of
14 radioactivity which was discussed in the exemption
15 request. Is that what you're referring to?

16 A. Yes. That's the hypothetical situation
17 I was considering at that early stage.

18 Q. And you would still agree if those
19 hypothetical conditions were true that, A, the cask
20 doesn't tip over and even if it does tip over there
21 would be no release of radioactivity, there would
22 be no compelling reason not to grant the exemption,
23 correct?

24 A. If I can phrase this as a hypothetical,
25 it would be a restatement of your question that a

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1 risk reduction ratio of 5 or greater had in fact
2 been achieved, and I have conceded that if that
3 were established with assurance, that that's where
4 my logic takes me.

5 Q. So in other words, that would be the
6 same as achieving the risk reduction of 5 or
7 more --

8 MS. CHANCELLOR: Objection.

9 MR. GAUKLER: -- Hypothetically.

10 MS. CHANCELLOR: Dr. Arabasz has
11 answered.

12 MR. TURK: I'm sorry, your Honor, I
13 didn't hear an answer to the question. I think
14 it's worth putting it on the record.

15 Q. (By Mr. Gaukler) Let me ask one
16 question and I'll try to rephrase it. So if I
17 understand your last answer, the showing that,
18 number one, the dry storage cask would not tip over
19 and, two, even if they did tip over with no release
20 of radioactivity would be the equivalent, assuming
21 that we're hypothetically correct, okay, that would
22 be the equivalent of showing a risk reduction
23 factor of 5 or more in the context of your Exhibit
24 208?

25 A. I answered yes earlier and I'm -- I have

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1 to take care here in what I'm interpreting on the
2 design side because I understand that it does
3 become complex on the engineering side what
4 elements enter into the factors of safety. But if
5 I allow you to ask me the question, if a risk
6 reduction ratio of 5 or more were established with
7 engineering correctness and assurance, would I then
8 agree that the 2,000-year return period were
9 justifiable, to that question I would say yes. If
10 that doesn't help you'll need to ask another
11 question.

12 Q. Let me rephrase it just slightly. If,
13 therefore, we show that the casks, assuming
14 hypothetically as Holtec has done analyses, and
15 assuming those analyses are correct, that at the
16 10,000-year earthquake the cask doesn't tip over;
17 and then further, that even assuming if it did tip
18 over there would be no release, that would be a
19 reduction factor of 5 or more then, as you
20 understood it, assuming that those were correct
21 statements hypothetically?

22 A. Yes. And I would add that it would
23 require more than if we showed, it would require
24 the judges on the Board to conclude.

25 Q. Right.

1 A. Or to accept that.

2 Q. If the Board were to conclude that, you
3 would agree then that there was a reduction factor
4 of 5?

5 A. I stand ready to adhere to whatever the
6 Board concludes.

7 Q. Enough of that. Thank you, Dr. Arabasz.

8 On this same point, you remember that
9 you had a discussion with Mr. Turk on Friday
10 afternoon, May 17th, going back again to
11 approximately three weeks ago already, about your
12 deferral to the State witnesses on the technical
13 questions of conservatism. Do you recall that?

14 A. Correct.

15 Q. And he was asking you about why you
16 deferred to the State as opposed to Dr. Cornell and
17 things of that nature. But let me just kind of
18 break up the issue. Isn't there really two issues
19 in terms of conservatism? One, there is kind of
20 the conservatisms that you normally find in design
21 codes and standards. That's one type of
22 conservatism, correct?

23 A. Correct.

24 Q. And then the other type of conservatism,
25 there might be a conservatism that you would show

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1 by analyses, specific analyses? For example, so
2 we're all talking the same wavelength, the analyses
3 that Holtec has done showing the casks don't tip
4 over at 10,000 years, assuming hypothetically that
5 were correct, that would be a conservatism that
6 would be shown by technical engineering analysis,
7 correct?

8 A. Yes. If I -- I said that I listened to
9 Dr. Cornell, and I continue to be educated, and my
10 understanding of seismic margins is a product of
11 the conservatism between the seismic loading and
12 the design procedures -- or excuse me, between what
13 would be called a demand analysis and a capacity
14 analysis.

15 Q. Right, right.

16 A. And if I understand correctly, the
17 equation that he puts forward, he actually brings
18 forward from NUREG 6728 and then goes through a
19 quantitative analysis, on the right-hand side of
20 that equation is a factor of safety. Part of that
21 factor of safety, as I understand that, is
22 established a priori as a matter of code or as a
23 matter of regulatory target. And the other part of
24 that margin, in terms of the margin as it relates
25 to a reference capacity, basically has to be

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1 validated by testing.

2 So in other words, one starts with a
3 desired factor of safety and another element on the
4 engineering side is somehow establishing that that
5 factor of safety, in fact, has been achieved.

6 Q. And it's recognized that various codes
7 and standards have various conservatisms imbued and
8 embodied in the codes and standards, correct?

9 A. That's correct. And Dr. Cornell
10 explained this in his attachment in referring to
11 the deterministic acceptance criteria in terms of a
12 factor that enters into that factor of safety term,
13 the difference between the DOE and the NRC policy
14 making, and in NUREG/CR 6728 there's a reference to
15 a 1.63 factor between, I believe, the seismic
16 loading and the so-called HCLPF point, high
17 confidence low probability of failure point.

18 Q. And you agree that Dr. Cornell is a
19 recognized expert in this area of evaluating
20 conservatisms that exist in codes and standards as
21 one of his areas of expertise?

22 MS. CHANCELLOR: Your Honor, I'm going
23 to object to this line of questioning. Dr. Arabasz
24 has not been put forward for the conservatisms or
25 lack thereof in PFS's design. He has testified

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1 that he hands that off to the State engineers and I
2 believe is beyond the scope of what we have offered
3 Dr. Arabasz for. And it doesn't relate to any
4 direct testimony that Mr. Gaukler is crossing on or
5 any follow-up to my redirect.

6 MR. GAUKLER: Your Honor, on Mr. Turk's
7 cross, he discussed this area. And this is my last
8 question and I'm going to move on.

9 JUDGE FARRAR: We'll allow it.

10 DR. ARABASZ: I'll need the question to
11 be repeated, please.

12 (Pending question read back as follows:)

13 "Q And you agree that Dr.
14 Cornell is a recognized expert in this
15 area of evaluating conservatisms that
16 exist in codes and standards as one of
17 his areas of expertise?"

18 THE WITNESS: As the question is
19 phrased, I agree.

20 Q. (By Mr. Gaukler) I would like to --
21 let's see. With Mr. Turk you were also discussing
22 the Geomatrix PSHA. Again, I'm going back, taking
23 you back to Friday afternoon, May 17th, and you
24 were discussing, I think, one of the initial
25 concerns you had with the initial site evaluation

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1 going back to 1997 before Geomatrix did its 1999
2 report was whether or not they had taken into
3 account a potential earthquake that could occur
4 along a fault that had not been previously
5 identified, correct?

6 A. I recall that, yes.

7 Q. And then I believe, if I understood you
8 correctly, Geomatrix did their evaluation,
9 identified the East fault and the West fault in
10 very close proximity to the site, correct?

11 A. Correct.

12 Q. And this was approximately the magnitude
13 or the approximate magnitude of earthquake you
14 might expect along the East fault was analogous to
15 what you might expect on a random earthquake on a
16 fault that had not been previously identified?

17 A. Correct.

18 Q. And therefore, by Geomatrix having done
19 this evaluation and having identified a fault that
20 had not been previously identified in close
21 proximity to the site, that would have reduced, in
22 your mind, one of the major uncertainties in terms
23 of correctly characterizing the seismicity of the
24 site and the appropriate ground motion for the
25 site; is that correct?

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1 A. The vibratory ground motion hazard, if I
2 can characterize it that way, correct.

3 Q. Okay. So if I understood your last
4 answer to my question, finding this fault close to
5 the site would have reduced -- reduces one of the
6 major uncertainties in terms of the appropriate
7 vibratory ground motion that would be experienced
8 at the site? Did I phrase it correctly or did I
9 not?

10 A. Maybe I messed you up a little bit in
11 terms of the seismic source characterization. Yes,
12 it removes the uncertainty in the seismic, whether
13 the seismic source characterization is adequate,
14 and that relates to the issue of the random
15 earthquake in the vicinity of the site, and in the
16 absence of good information whether there's a
17 potential that that random earthquake may occur
18 beneath or very close to the site.

19 Q. So that reduced or eliminated that
20 uncertainty then?

21 A. In my mind, correct.

22 Q. I would like just to go back, I have one
23 last topic I have a few questions on, and this is
24 the issue of annual risk versus lifetime risk and
25 to what extent one should take into account the

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1 duration of a facility in determining the
2 appropriate ground motion.

3 Assuming hypothetically one were to say
4 that because we intend to operate for 40 years, one
5 ought to maybe increase the 2,000 year to a higher
6 level, which is what you were following up on the
7 Staff's logic of their initial statement, I take it
8 the same logic, if you were to apply that logic,
9 the same thing would work in the opposite
10 direction; assuming that somebody came in and said
11 you were only going to use a 10-year facility then
12 you would only need to have a design basis
13 earthquake of 1000 years if you were to refocus on
14 lifetime, correct?

15 A. Please don't lead me, Mr. Gaukler, with
16 your head nodding.

17 Q. I'm just trying to say -- I'm sorry. I
18 know you're independent enough you're not
19 influenced by my head nodding, Dr. Arabasz.

20 A. I'm considering this carefully because
21 I've reviewed a monograph by Dr. McGuire dealing
22 with this issue and describing the illogic of the
23 very short lifetime in terms of a total exceedance
24 of probability. And I guess what I would come down
25 to is some baseline below which I would not

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1 increase the allowed probability of exceedance. At
2 bottom, Dr. Cornell has given you a very clever
3 question to put to me. And if you came up with
4 this question on your own, I'm greatly impressed
5 with your --

6 Q. No.

7 A. You're learning from Dr. Cornell's side.

8 Q. I have to attribute this, in truth, to
9 Dr. Cornell.

10 A. I'm sorry, I don't mean to take this
11 lightly, I'll need to have the question restated.

12 (Pending question read back as follows:)

13 "Q Assuming hypothetically one
14 were to say that because we intend to
15 operate for 40 years, one ought to maybe
16 increase the 2,000 year to a higher
17 level, which is what you were following
18 up on the Staff's logic of their initial
19 statement, I take it the same logic, if
20 you were to apply that logic, the same
21 thing would work in the opposite
22 direction; assuming that somebody came
23 in and said you were only going to use a
24 10-year facility then you would only
25 need to have a design basis earthquake

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1 of 1000 years if you were to refocus on
2 lifetime, correct?"

3 THE WITNESS: I've committed myself to
4 logic and so I'll follow it with the qualification,
5 again, that there would be some baseline stipulated
6 by code or regulatory policy below which I would
7 not go.

8 Q. (By Mr. Gaukler) So the answer would be
9 yes, if I understood your answer?

10 A. Yes.

11 Q. Two other questions to follow-up just on
12 this same line. Basically we've kind of arrived at
13 a consensus, at least on a national basis, that the
14 design basis earthquake for nuclear power plants is
15 approximately 1 times 10 to the minus 4 or
16 10,000-year mean return period earthquake?

17 A. The first part of your question again?

18 Q. Assuming that we've discussed -- just
19 assume for purposes here that the 10,000-year
20 design basis earthquake is a earthquake that would
21 approximate the design basis earthquakes for
22 nuclear power plants in the United States, which
23 we've discussed generally.

24 A. Generally, yes, absent other regulatory
25 decision making.

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1 Q. So let's assume for purposes of this
2 question that that is hypothetically correct.
3 Nuclear power plants are licensed initially for 40
4 years and had this design basis earthquake
5 established at the time of their licensing. We are
6 now going through a process where most nuclear
7 power plants are going through relicensing and
8 they're getting a new license, extending their
9 license for another 20 years.

10 Does the fact at this point, assume you
11 were using an annual lifetime risk consideration in
12 establishing an appropriate earthquake design level
13 initially, does the fact that you are now having
14 these licenses extended somehow invalidate that
15 initial determination of the appropriate design
16 basis earthquake for the nuclear power plants, in
17 your mind?

18 MS. CHANCELLOR: Could I just ask a
19 question? Is this a hypothetical that previous
20 nuclear power plants were designed to a 10,000-year
21 mean return period earthquake as opposed to a
22 deterministic?

23 MR. GAUKLER: Yes. I think it's
24 hypothetical. We've discussed this and I think
25 we've agreed this is an approximation that may well

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1 be correct, but for purposes of this question it's
2 just hypothetical.

3 MS. CHANCELLOR: But the approximation
4 was for a new nuclear power plant, not for an old
5 nuclear power plant.

6 MR. GAUKLER: We won't discuss that,
7 just hypothetically.

8 MS. CHANCELLOR: Okay.

9 DR. ARABASZ: Okay. The mixed elements
10 here are knowing in advance what your exposure
11 period realistically will be as opposed to guessing
12 what it will be. In the case of the nuclear power
13 plants, guessing 40 years and having to revisit the
14 extended lifetime later.

15 Q. (By Mr. Gaukler) Yes. Nuclear power
16 plants were initially licensed for 40 years. I
17 don't know to what extent people thought about
18 licensing back then, but they were licensed for 40
19 years. And now at this point in time, most power
20 plants are coming in for relicensing to extend
21 their license for another 20 years.

22 And does the fact that now all of a
23 sudden we're increasing their total life from what
24 we had expected initially from 40 years to 60
25 years, does that somehow invalidate in your mind

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1 the original determination as to the
2 appropriateness of my hypothetical 10,000-year
3 design basis earthquake?

4 A. I don't know.

5 Q. And given these uncertainties in terms
6 of lifetime, isn't really the best way just to
7 focus on the annual or some frequency of
8 probability of exceedance as the appropriate basis
9 for determining the appropriate design basis
10 earthquake for a facility such as the PFS?

11 A. Somewhere in your train was "best" and
12 also "appropriate." And I'll answer, it all
13 depends on the context, what the pertaining
14 regulatory guidance is to be and whether there is a
15 clearly established framework for the decision
16 making. If the established -- if the DOE framework
17 is established then that would lead me in one
18 direction. If not, then I have to go to another
19 arena for considering acceptable risk.

20 Q. And in the DOE framework it would be the
21 mean annual frequency that would be the basis for
22 determining the appropriate design basis
23 earthquake, right?

24 A. Correct.

25 MR. GAUKLER: I have no further

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1 questions.

2 JUDGE FARRAR: Mr. Turk, I assume you'll
3 have some questions. In terms of planning the
4 break, how long do you think you'll need?

5 MR. TURK: I'll need to talk to Dr.
6 Stamatakos to resolve that. In fact, it may be
7 that in order to expedite I'll ask permission to
8 have Dr. Stamatakos ask a few questions after I'm
9 done with the ones that I have planned to ask. I
10 would estimate 20 minutes. One of the areas that
11 we were going to explore is quite technical so it
12 may go into 30 minutes.

13 JUDGE FARRAR: If I recall correctly,
14 there's a provision in the rules that specifically
15 authorizes questioning by a non-lawyer person?

16 MR. TURK: I believe that's correct, as
17 long as the Licensing Board determines that it's
18 permissible.

19 JUDGE FARRAR: The reason I'm looking at
20 my watch, it has nothing to do with you, but I have
21 an appointment to make a call back to our office on
22 logistical things, which I need to do before 1:00.
23 Do you think you can finish well before then? Or
24 why don't you get started and we'll take it a few
25 minutes and see what happens. What's Dr.

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1 Bartlett's situation, Ms. Chancellor?

2 MS. CHANCELLOR: Here for the duration,
3 your Honor.

4 JUDGE FARRAR: Oh, okay. I thought
5 there was some limitation on his --

6 MS. CHANCELLOR: It's Dr. Ostadan. And
7 we'll need to start Dr. Ostadan and Dr. Bartlett
8 first thing tomorrow on a different set of
9 testimony on the Part D portion. Dr. Bartlett,
10 with respect to seismic exemption, doesn't have any
11 scheduling constraints.

12 JUDGE FARRAR: Fine.

13 MR. TURK: May I suggest, your Honor, so
14 that Dr. Stamatakos and I can talk, perhaps take
15 the lunch break now and come back?

16 JUDGE FARRAR: Okay. I thought that
17 might make sense. I should note that Dr.
18 Stamatakos may decide he would rather sit in the
19 back row, in which case I will do it myself.

20 JUDGE FARRAR: I was rereading a
21 transcript the other day of the one witness we kept
22 calling on who decided he was going to leave the
23 hotel and be out of our reach.

24 Let's take a slightly longer break than
25 usual because my call may take a good amount of

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1 time. It's 12 after, let's come back at 20 after
2 1:00.

3 (Noon recess taken.)

4 JUDGE FARRAR: When we broke we were
5 going to begin the Staff's second round of
6 cross-examination, and Mr. Turk, you had suggested
7 you wanted to proceed with Dr. Stamatakos
8 conducting the questioning?

9 MR. TURK: What I'd like to do, your
10 Honor, is conduct the cross-examination for the
11 Staff, and at some point when we get to a technical
12 area that I think would be more expeditious for
13 Dr. Stamatakos to inquire about, I would ask at the
14 time.

15 JUDGE FARRAR: And that would be under
16 Section 2.733 of part 2 which allows you to ask us
17 to do this, and according to that we'd have to make
18 three findings which I'll paraphrase: that he's
19 qualified by scientific training to contribute,
20 which one would think would be the case. If he's
21 read any written testimony on which he intends to
22 examine or cross-examine on any new documents, I
23 assume that's the case. And that he's prepared
24 himself to conduct a meaningful and expeditious
25 examination or cross-examination.

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1 MR. TURK: I can attest to all three of
2 those, your Honor.

3 JUDGE FARRAR: To save time, when we get
4 to that point will there be any objection to us
5 proceeding that way?

6 MS. CHANCELLOR: Provided there isn't
7 tag teaming, your Honor, I wouldn't have any
8 objection. So in other words, if Dr. Stamatakos
9 asks a question and then Mr. Turk jumps in with a
10 follow-up, it would get very confusing. So if he's
11 going to pass the baton to Dr. Stamatakos, it
12 should stay passed until it's passed back
13 definitively.

14 JUDGE FARRAR: Well, we've tried to
15 avoid tag teaming in this proceeding, not always
16 successfully, so we'll deal with that when we come
17 to it. Mr. Gaukler, will you expect to have any
18 objection?

19 MR. GAUKLER: I have no objection.

20 JUDGE FARRAR: All right, then Mr. Turk,
21 go ahead.

22 MR. TURK: Your Honor, before we begin
23 the examination I'd like to introduce a Staff
24 exhibit which we discussed previously. The parties
25 and the licensing Board may recall we examined on

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1 the TMI-2 ISFSI license on March 19th, 1999. And
2 I'd like to have marked for identification at this
3 time Staff Exhibit SS.

4 (STAFF EXHIBIT SS MARKED.)

5 MR. TURK: For the record, let me
6 identify this document as follows. It consists of
7 a cover letter from E. William Brach, director of
8 the spent fuel project office, to Warren Bergholz,
9 acting manager of the Idaho Operations Office, U.S.
10 Department of Energy, dated March 19, 1999.

11 Attached to the cover letter is a
12 two-page document which bears the title TMI-2
13 Independent Spent Fuel Storage Installation
14 Materials License No. SNM-2508, and it includes the
15 docket number and the name of the licensee. For
16 brevity's sake I won't state the whole thing.

17 Behind those two pages are found three
18 pages which are the license for independent storage
19 of spent nuclear fuel and high-level radioactive
20 waste, license No. SNM-2508. Behind that is a
21 cover page of the Safety Evaluation Report for the
22 TMI-2 spent fuel storage installation.

23 And behind that cover page is Section
24 2.5.6.2 entitled Vibratory Ground Motion. This is
25 pages 2-17 through 2-26 of the Staff's SER for that

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1 facility.

2 Q. And by way of identification, I would
3 ask the witness if in fact this is the document
4 that we inquired about previously which I showed to
5 him which contained the TMI-2 ISFSI license
6 including the exemption from the provisions of
7 72.102(f)(1), which appears on page 2, paragraph
8 12a of the license in this exhibit.

9 A. Yes, I recall this document.

10 MR. TURK: Your Honor, I would offer
11 this into evidence and ask that it be admitted at
12 this time.

13 JUDGE FARRAR: Any objection?

14 MS. CHANCELLOR: No objection, your
15 Honor.

16 MR. GAUKLER: No objection.

17 JUDGE FARRAR: Then it will be admitted.

18 (STAFF'S EXHIBIT SS WAS ADMITTED.)

19

20 RECROSS-EXAMINATION

21 BY MR. TURK:

22 Q. Dr. Arabasz, starting with this subject
23 pertaining to which the Staff Exhibit SS pertains,
24 that is, the Three Mile Island 2 ISFSI license and
25 exemption, I believe you had testified yesterday

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1 that you presumed or assumed that DOE performed an
2 analysis of demonstrating performance goals
3 consistent with the DOE 1020 standard for that
4 ISFSI. Do you recall that part of your testimony?

5 A. No, I do not.

6 Q. Is it your belief that DOE did perform a
7 1020 type analysis with respect to the exemption
8 request for the TMI-2 ISFSI?

9 A. No, that's not my understanding.

10 Q. In your testimony today and also
11 yesterday, you referred to a bullet, and this is in
12 State Exhibit 209. On the first page of that
13 exhibit, the last bullet states, "In its Fault
14 Evaluation Study and Seismic Hazard Assessment
15 Study--Final Report for the site, Geomatrix
16 consultants, Inc. (1999a) concluded that an
17 appropriate design probability level for both
18 vibratory ground motion and fault displacement for
19 the site is 5 times 10 to the minus 4 (or a
20 2,000-year return period)." And that bullet is
21 taken from Staff Exhibit A, the Preliminary Safety
22 Evaluation Report dated December 15, 1999?

23 A. Correct. I have that in front of me.

24 Q. I believe you indicated this was
25 circular reasoning or circular logic in that in

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1 your view the Geomatrix report had simply referred
2 to the Staff paper before.

3 A. The argument was developed in a prior
4 state filed document. I can't recall the exact
5 document. I do recall going back to the Geomatrix
6 report and discovering that the arguments that were
7 put forward by Geomatrix, to the best of my memory,
8 related to either -- well, they basically related
9 to NRC and/or Staff decisions or positions.

10 Q. Which Geomatrix document are you
11 referring to now? Is it the one that's referenced
12 here as 1999(a)?

13 A. Correct, yes.

14 Q. Do you happen to know the date of that
15 document?

16 MS. CHANCELLOR: Your Honor, is this a
17 relevant question? 1999(a) --

18 MR. GAUKLER: I believe it's February
19 1999.

20 Q. (By Mr. Turk) Do you recall if that's
21 the document that you're referring to?

22 A. It's the February 1999 Geomatrix PSHA
23 document.

24 MR. TURK: Your Honor, I'd like to
25 distribute at this time a copy of a document, and

1 I'd like to have this marked for identification as
2 Staff Exhibit TT.

3 (STAFF'S EXHIBIT TT MARKED.)

4 MS. CHANCELLOR: Just as a point of
5 reference, Dr. Arabasz was looking for a document
6 that the State filed that challenged this Staff's
7 circular reasoning, and I would identify for the
8 record that that was contained in State of Utah's
9 Request for Admission of late filed basis 2 to
10 Contention L on January 26, 2000 at page 18.

11 MR. TURK: May we go off the record?

12 JUDGE FARRAR: Yes.

13 (Discussion off the record.)

14 JUDGE FARRAR: And before you make the
15 request, I'll make the request. We're at the end
16 of a long -- no, we're not at the end. We're
17 heading toward the end of a long, difficult,
18 complex proceeding. There are documents all over
19 the place that have shown up at different times.
20 It's getting very difficult for everybody to track
21 them. So the simplest way possible that whoever
22 can give a reference when it's needed gives it in
23 non-confrontational tones, and we will move along
24 much better.

25 MR. TURK: Your Honor, it has been a

1 long proceeding and it is a difficult area to
2 examine upon, and I would appreciate it if
3 interruptions were kept to a minimum. I don't know
4 understand why that last interruption was necessary
5 at this time.

6 JUDGE FARRAR: Well, without passing on
7 one interruption or another, let's all try to
8 provide references when we can that will make
9 things easier on the witnesses and counsel and let
10 us move faster.

11 Q. (By Mr. Turk) Dr. Arabasz, do you have
12 in front of you a document that's been marked for
13 identification as Staff Exhibit TT?

14 A. I do.

15 Q. Let us identify this as cover page
16 entitled Final Report--Volume I of III, Fault
17 Evaluation Study and Seismic Hazard Assessment,
18 Private Fuel Storage Facility, Skull Valley, Utah,
19 prepared by Geomatrix Consultants, Inc., February
20 1999. Behind that cover page are pages 54 to 56 of
21 the document.

22 Is this the document that you referred
23 to in commenting upon this bullet in State Exhibit
24 209?

25 A. Yes, it appears to be.

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1 Q. And do you see in this document a
2 discussion by Geomatrix providing reasons why a
3 2,000-year return period would be appropriate for
4 the PFS site?

5 A. Yes, I do.

6 MR. TURK: Your Honor, at this time may
7 I offer and request that this document be admitted
8 into evidence?

9 MS. CHANCELLOR: Objection on the
10 relevance of the document, your Honor.

11 MR. TURK: If it's not relevant, then
12 why are we hearing testimony about this document?

13 JUDGE FARRAR: I thought it's relevant
14 because it's referred to in the bullets that the
15 witness talked about, in the Staff document that
16 the witness -- critiqued, if that's the right word.

17 MS. CHANCELLOR: If Mr. Turk is going to
18 connect it up, that's fine, your Honor.

19 JUDGE FARRAR: Well, objection
20 overruled. We'll admit the document.

21 (STAFF EXHIBIT TT WAS ADMITTED.)

22 MR. TURK: Thank you, your Honor.

23 Q. (By Mr. Turk) In fact, if you turn to
24 page 55 in this document, you see that the first
25 paragraph at the top discusses the NRC

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1 recommendation in SECY-98-126 that probabilistic
2 approaches be taken for dry cask storage system
3 licensing?

4 A. I see that.

5 Q. And you see in the next paragraph which
6 starts off with the words, "Until the Part 72
7 rulemaking is completed, there is only indirect
8 guidance from the Staff regarding the appropriate
9 probability level for seismic design"?

10 A. I see that.

11 Q. And in that paragraph do you see where
12 Geomatrix recites the TMI-2 ISFSI exemption in
13 which a 2,000-year return period was approved?

14 A. I see that.

15 Q. And do you see also a discussion in that
16 same paragraph of the DOE Standard 1020 which
17 concludes for PC 3 that an appropriate mean ground
18 motion corresponding to a 2,000-year return period
19 would be appropriate for a PC 3 facility?

20 A. Yes.

21 Q. And do you also see in that same
22 paragraph a discussion of the 1020 standard which
23 concludes with in this paragraph the statement
24 "Considering th minor radiological consequences
25 from a canister failure, and the lack of a credible

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1 mechanism to cause a failure, the staff finds that
2 the DOE approach of using the 2,000-year return
3 period mean ground motion as the design earthquake
4 for dry storage facilities is adequately
5 conservative"?

6 A. I see that, yes.

7 Q. So in fact, and incidentally, on the
8 next page, page 56, the concluding paragraph in
9 this section states, based on -- "Based on the
10 above arguments for a risk-informed graded
11 approach, we conclude that an appropriate design
12 probability level for the PFSF site is 5 times 10
13 to the minus 4 (2,000-year return period)." Do you
14 see that statement?

15 A. Yes, I do.

16 Q. So in fact, in February 1999 Geomatrix
17 proposed a 2,000-year return period ground motion
18 for the PFS facility, did it not?

19 A. I don't -- well, I'm pausing because of
20 the distinction between proposed and concluded,
21 Geomatrix concluding the appropriateness of a
22 design level as opposed to proposing the design
23 level.

24 Q. Well, perhaps you disagree with the word
25 "proposed." Are you saying that their conclusion

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1 that 2,000 years was appropriate?

2 A. That's what I read, yes.

3 Q. And you recognize that this document was
4 submitted to the NRC -- I'm sorry -- this document
5 was authored and completed prior to the submission
6 of the PFS exemption request on April 2, 1999?

7 A. I see that.

8 Q. And you also recognize, then, that this
9 document was authored and completed prior to the
10 Staff suggesting to PFS that they use a 2,000-year
11 return period in connection with their PSHA
12 request, correct?

13 A. I follow that timeline, yes.

14 Q. And you agree that's correct?

15 A. Correct.

16 Q. So is it fair to say that your belief
17 that -- I'm sorry, strike that.

18 In your testimony yesterday you were
19 addressing certain statements that appeared in your
20 April 1999 report to the State of Utah, and you
21 stated that some of the conclusions which are
22 mentioned in your issues and perspective paper are
23 not your views today and that your views fell by
24 the wayside when the Staff issued its rationale for
25 a 2,000-year return period. Do you recall that

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1 part of your testimony?

2 MS. CHANCELLOR: Objection to the
3 characterization of the testimony, your Honor.

4 MR. TURK: All right.

5 Q. Did you find my characterization to be
6 incorrect?

7 A. I'd need to have it restated. I was
8 distracted.

9 MS. CHANCELLOR: It was the last part of
10 Mr. Turk's question that Dr. Arabasz changed his
11 mind based on the Staff's question.

12 JUDGE FARRAR: Let's have it read back.

13 MR. TURK: Your Honor, I can cut it
14 short. I'll read the testimony into the record.

15 Q. (By Mr. Turk) At page 10057 continuing
16 on to page 10058 --

17 JUDGE FARRAR: Of which day?

18 MR. TURK: Of testimony from yesterday,
19 June 5.

20 Q. (By Mr. Turk) Do you have that before
21 you?

22 A. Almost. Yes, I'm there.

23 Q. Ms. Chancellor asked you in her redirect
24 the following question. Quote, "And the views
25 expressed in this paper of April of 1999, are they

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1 still views you hold today?" Do you see that
2 question?

3 A. Yes, I do.

4 Q. And you answered, "No, they're not, and
5 they fell by the wayside pretty quickly with the
6 issuance of the Staff's reasoning for justifying
7 the 2,000-year return period ground motion, and
8 that began the -- I guess the trail of my
9 challenging the reasons that they offered for the
10 2,000-year return period ground motion," close
11 quote. Have I read that correctly?

12 A. Correct.

13 Q. In fact, you recognize now that the
14 rationale contained in the Staff's December 1999
15 SER, preliminary SER, fairly closely resembled the
16 points made by Geomatrix in its February 1999
17 document, correct?

18 A. That's correct. The context of the
19 April 1999 was a review of the exemption request.

20 Q. And you had not reviewed the Geomatrix
21 report when you commented to the State in April of
22 1999 on the exemption request?

23 A. Yes, I had. That was part of the review
24 process.

25 Q. Thank you. Also in your testimony

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1 yesterday you were commenting upon the concept of
2 risk as discussed in NRC Regulatory Guide 1.165.
3 Do you recall that part of your testimony?

4 A. Specifically the reference B.4 in
5 Appendix B.

6 Q. When you mentioned reference B.4, I take
7 it you're referring now to something that appears
8 in Reg Guide 1.165?

9 A. That's correct. What you pointed me to
10 originally was part of my November 2000 statement
11 or argument supported by my declaration.

12 MR. TURK: Your Honor, I would like to
13 distribute another document at this time.

14 MS. CHANCELLOR: Had Dr. Arabasz
15 finished his answer?

16 Q. (By Mr. Turk) Had you finished your
17 answer?

18 A. Yes.

19 MR. TURK: And I would ask that this
20 document be marked for identification as Staff
21 Exhibit UU.

22 (STAFF'S EXHIBIT UU MARKED.)

23 For the record, let me identify this
24 document as follows. It is page 1 of Regulatory
25 Guide 1.165 dated March 1997 followed by pages

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1 1.165-12 and 1.65-16.

2 Q. Do you have that document in front of
3 you, Dr. Arabasz?

4 A. Yes, I do.

5 Q. And this is in fact a correct
6 replication of those two pages of the Reg Guide
7 1.165, is it not?

8 A. It certainly appears to be, yes.

9 Q. And at page 1.165-12 -- and by the way,
10 this page, page 12 of the document, is also
11 contained in a Staff -- in a State of Utah exhibit,
12 is it not?

13 A. I believe that's correct.

14 MS. CHANCELLOR: State's Exhibit 201,
15 Mr. Turk.

16 Q. (By Mr. Turk) State Exhibit 201,
17 however, does not contain the following page that
18 I've appended here, which is page 16, which is the
19 reference, correct?

20 A. Correct.

21 Q. And in fact, if we look at the bottom of
22 page 12 of Staff Exhibit UU for identification, in
23 the first column the following statement appears,
24 and I believe this is the statement that you
25 discussed yesterday with Ms. Chancellor.

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1 "Reference B.4 includes a procedure to determine an
2 alternate" -- I'm sorry, "an alternative reference
3 probability on the risk-based considerations; its
4 application will also be reviewed on a case-by-case
5 basis." Have I read that correctly?

6 A. Yes, you did.

7 Q. And this is the statement which leads
8 you to conclude, if I understand your testimony
9 from yesterday, that Reg Guide 1.165 when it uses
10 the word "risk" was discussing risk as equivalent
11 to a seismic hazard rather than any type of
12 radiological risk. Is that correct?

13 A. No. If I may explain.

14 Q. Yes.

15 A. The reference to risk is specifically
16 within the context of reference B.4, and the full
17 text that began this line of questioning, as I
18 recall, was you were pointing me to text in a
19 November 2000 state submitted document. This is
20 where you began the line of questioning asking me
21 whether I and the State in its contention as one of
22 the subsections of Utah QQ/LL E, part E, were
23 challenging that the Staff had not taken risk into
24 consideration in, to the best of my memory,
25 establishing a 2,000-year return period.

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1 Q. I'd ask you to turn to pages 10064
2 through pages 10067 of your testimony of yesterday.

3 A. Yes, I have that.

4 Q. Ms. Chancellor asked you the following
5 question beginning at the bottom of page 10064.
6 "Dr. Arabasz, in the November 9, 2000 State's
7 request for modification of Utah L, Basis 2, when
8 you referred to risk, are you referring to
9 radiological risk?" Do you see that question?

10 A. Yes, I do.

11 Q. And you answered -- it's a pretty long
12 answer. I'll read the first sentence. "No" --
13 quotes, "No. What I am referring to is the risk as
14 referenced in Appendix B to Reg Guide 1.165." Then
15 you go on with a longer paragraph which is in the
16 record; we don't need to repeat it now. And then
17 -- and you're welcome to take a look at that again
18 as we study your testimony.

19 A. Yes, yes.

20 Q. And then Ms. Chancellor asked you the
21 following question. "This is State's Exhibit 201a;
22 is that correct?" And your answer, yes -- I'm
23 sorry -- you answer, quote, "Yes, that's correct,"
24 close quote, and then you referred to this
25 reference probability discussion. Can you see that

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1 in your testimony?

2 A. Yes, I do.

3 Q. And that discussion that appears
4 starting at the bottom of 10065 and continuing into
5 10066 is a discussion of that same paragraph that I
6 read into the record a short time ago from Staff
7 Exhibit UU for identification, is it not? In other
8 words, the sentence that begins with the words,
9 quote, "Reference B.4 includes a procedure--"

10 A. Yes.

11 Q. "-- to determine an alternative
12 reference probability on the risk-based
13 considerations?

14 A. Yes.

15 (A recess was taken.)

16 JUDGE FARRAR: Let's see how much
17 progress we can make. Go ahead, Mr. Turk.

18 Q. Dr. Arabasz, before that unexpected
19 break I was asking you about your testimony at page
20 10066 and the testimony begins at the bottom of
21 10065 in response to Ms. Chancellor's question
22 whether what you're discussing is State's Exhibit
23 201. Do you see where we were in the testimony
24 there?

25 A. Yes, I can.

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1 Q. At the bottom of page 10066 you indicate
2 that the reference to B.4 -- and here when you say
3 the reference to B.4 you're referring to Reg Guide
4 1.165 where it mentions reference B.4, correct?

5 A. Correct.

6 Q. You indicate that's a position paper by
7 the Nuclear Energy Institute which, as you state,
8 quote, "puts forward thinking about what one should
9 do if one wants to achieve risk consistency from
10 site to site across the country." You continue in
11 your testimony to state, "And the elements that
12 enter into that consideration include the relative
13 slopes of hazard curves in different parts of the
14 country, the robustness of the SSC's, or the --
15 whatever elements are being designed, basically the
16 design conservatisms and so on." I read that
17 correctly?

18 A. You did.

19 Q. And then you continue on 10067 by
20 stating, "so in that context the risk is risk
21 consistency for the same probability of failure
22 across the country; it doesn't relate to a
23 radiological risk or a formal PRA as understood."
24 Have I read that correctly?

25 A. Did you.

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1 Q. So your understanding, then, of Reg
2 Guide 1.165 and its reference in this paragraph to
3 reference B.4 is that this is not a radiological
4 risk consideration. That's your understanding,
5 correct?

6 A. The part of Reg Guide 1.65 meaning this
7 reference B.4, that's my understanding.

8 Q. And then reference B.4, that's the
9 document that appears cited at the back of Staff
10 Exhibit TT -- I'm sorry, Staff Exhibit UU as item
11 B.4 on page 16, which is listed as, quote,
12 "Attachment to Letter from D.J. Modeen, Nuclear
13 Energy Institute, to A. J. Murphy, USNRC, Subject:
14 Seismic Siting Decision Process, May 25, 1994,"
15 correct? That's the B.4 reference that you were
16 discussing?

17 A. Yes.

18 MR. TURK: Your Honor, at this time I'd
19 like to ask for Staff Exhibit UU to be admitted
20 into evidence.

21 MR. GAUKLER: No objection, your Honor.

22 MS. CHANCELLOR: No objection.

23 JUDGE FARRAR: All right, UU will be
24 admitted.

25 (STAFF EXHIBIT UU WAS ADMITTED.)

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1 MR. TURK: And just so we're clear: this
2 is essentially identical to the state's exhibit
3 except that it includes the page 16 with the
4 references.

5 MS. CHANCELLOR: Even though it's almost
6 duplicative, I won't object, your Honor.

7 Q. (By Mr. Turk) Now, had you read that
8 reference B.4 before you testified about it?

9 A. I have information in front of me that
10 allows me to say yes.

11 Q. My question is, did you read reference
12 B.4?

13 A. Before the November --

14 Q. Before you testified yesterday.

15 A. Yes.

16 Q. So you're familiar with that document?

17 A. Yes, I am.

18 (A recess was held.)

19 JUDGE FARRAR: All right. We're back,
20 ready to go.

21 MR. TURK: Your Honor, at this time I'd
22 like to distribute another document. I'll ask to
23 have this document marked for identification as
24 Staff Exhibit VV, as in Victor.

25 (STAFF EXHIBIT-VV WAS MARKED.)

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1 MR. TURK: And let me identify this
2 document as follows: It consists of a cover page,
3 a letter from David J. Modeen of the Nuclear Energy
4 Institute to Dr. Andrew J. Murphy of the NRC,
5 Office of Nuclear Regulatory Research, dated May
6 25, 1994. As part of this exhibit, behind the
7 cover page I've inserted the cover page of the
8 attachment entitled "Seismic Siting Decision
9 Process" prepared by the Nuclear Energy Institute,
10 May 24, 1994 and behind that the cover page to
11 Appendix C of that document entitled "Site-Specific
12 Consideration of the Reference Probability." And
13 then I've attached certain pages from that Appendix
14 C, pages C-1 and C-2 and then pages C-10 through
15 C-14.

16 Q. Dr. Arabasz, have you seen this letter
17 before?

18 A. Not the letter itself. I received
19 through a document request the attachment certified
20 to be the attachment to the letter.

21 Q. And that would be the attachment which
22 begins with the second page entitled "Seismic
23 Siting Decision Process"?

24 A. Correct.

25 Q. Does this document on its face appear to

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1 be Reference B.4 in Reg Guide 1.165?

2 A. Yes.

3 Q. Would you accept my representation that
4 it is, in fact, Reference B.4?

5 A. Yes.

6 MR. TURK: Your Honor, I'd like to offer
7 this exhibit.

8 MS. CHANCELLOR: No objection,
9 Your Honor.

10 MR. GAUKLER: No objection, Your Honor.

11 JUDGE FARRAR: Then VV will be admitted.

12 (STAFF EXHIBIT-VV WAS ADMITTED.)

13 Q. (By Mr. Turk) And you mentioned that
14 you've seen the attachment to the letter which is
15 entitled "Seismic Siting Decision Process." Do you
16 recognize that the following page, Appendix C, is
17 also part of that submittal from the NEI to the
18 NRC?

19 A. I do.

20 Q. Dr. Arabasz, before I begin examination
21 of this document, are you familiar with the fact
22 that risk has a special regulatory usage and
23 understanding in NRC parlance?

24 A. No, I'm not.

25 Q. Have you ever heard the equation that

1 risk equals probability times consequences?

2 A. Yes.

3 Q. And are you aware that that's the usage
4 of the word "risk" in NRC parlance?

5 A. As you've explained it to me, I
6 understand that.

7 Q. Before today you did not?

8 A. I was certainly aware of definitions of
9 risk within the seismic hazard community, but some
10 particular nuance or definition that it might have
11 within NRC policy making or regulations, no, not
12 specifically.

13 Q. So you weren't aware that that was the
14 way the word "risk" is used in NRC parlance before
15 I mentioned it to you today?

16 A. Correct.

17 Q. I'd like you to look at page C-2 of this
18 document, Staff Exhibit VV, and there is a
19 paragraph in the middle of the page which states as
20 follows: "The purpose of this appendix is to
21 describe the conditions for which an adjustment of
22 the PR for a site might be considered by an
23 applicant."

24 Do you see that statement?

25 A. Yes, I do.

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1 MR. TURK: I won't read more from the
2 document, Your Honor. It is in evidence, and we
3 can all turn to it as we deem necessary.

4 Q. If you would, turn to page C-10. Do you
5 see the section entitled "C.7, Evaluation of
6 Seismic Risk"?

7 A. Yes, I do.

8 Q. In the first paragraph of that section,
9 the following statement appears -- and please tell
10 me if I read it correctly -- To develop guidance
11 when a site specific modification of the RP may be
12 warranted an evaluation for selected sites located
13 in the SCR, close quote.

14 I did read that to be evaluation rather
15 than evaluations.

16 A. You did.

17 Q. I corrected the typo --

18 A. Yes.

19 Q. -- on my own.

20 And SCR, it stands for stable
21 continental region --

22 A. Yes.

23 Q. -- is that correct?

24 A. In other words, the central -- it means
25 here in the United States.

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1 Q. There will be one SCR, correct, the
2 central and eastern United States --

3 A. Would be start of the stable continental
4 region.

5 Q. And what's your understanding of what
6 the stable continental region consists of?

7 A. The core of a continental region which
8 would have ancient rocks unaffected by relatively
9 young geological deformation.

10 Q. Would the SCR include the western United
11 States? Would the same SCR that includes the
12 central and eastern United States also include the
13 western United States?

14 A. No.

15 Q. The second sentence in that same
16 paragraph read as follows: "The purpose of this
17 assessment is to characterize the hazard at these
18 sites in terms of hazard curve slopes and ground
19 motions that contribute to the risk of seismically
20 initiated core damage at future reactors."

21 Do you see that statement?

22 A. Yes, I do.

23 Q. And do you know what is meant by the
24 term "seismically initiated core damage"?

25 A. I believe I do.

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1 Q. Would you give me your understanding of
2 that term?

3 A. This would be core damage, some failure
4 induced by a seismic event.

5 Q. And when we're speaking of core, is that
6 the reactor core? Do you know?

7 A. I do not know. I assume that.

8 Q. Do you know if that's associated with
9 the reactor vessel in any way?

10 A. I assume it is.

11 Q. Do you understand -- assuming that your
12 assumption is correct, do you understand, then,
13 that what this sentence discusses is the
14 correlation of seismic hazard with the risk of
15 inducing core damage in a reactor vessel?

16 A. Yes. That's consistent with the
17 analytical consideration of capacity as part of
18 the -- a seismic risk consideration.

19 Q. Do you understand that core damage --

20 MS. CHANCELLOR: Just a moment. I don't
21 believe Dr. Arabasz has finished.

22 Had you?

23 THE WITNESS: Perhaps I'm speaking out
24 of turn.

25 MS. CHANCELLOR: Go ahead if you haven't

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1 completed your answer.

2 THE WITNESS: I'll stop there.

3 Q. (By Mr. Turk) In the next paragraph,
4 the paragraph begins by stating, "To assess the
5 risk of a seismically initiated accident at a
6 future commercial nuclear power plant, two
7 approaches are considered," and then two
8 alternatives are mentioned.

9 Do you understand that a seismically
10 initiated accident refers to the potential for an
11 accident involving the potential release of
12 radiological materials from a nuclear reactor?

13 A. Yes.

14 Q. In the first paragraph, numbered
15 paragraph that follows, there's a discussion of
16 future reactors and an assumption that there will
17 be a standard plant design with a certain peak
18 ground acceleration safe shutdown earthquake.

19 Do you see that?

20 In fact, let me read it. One, in the
21 first case, it is assumed that a future reactor
22 will be a standard plant design with a 0.30 g peak
23 ground acceleration (PGA) SSC.

24 Do you see that?

25 A. Yes, I do.

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1 Q. Do you understand what a safe shutdown
2 earthquake is?

3 A. Yes, I do.

4 Q. And could you provide your understanding
5 of an SSE?

6 A. A safe shutdown earthquake would be an
7 earthquake incident in which the plant would remain
8 functional and able to shut down without some
9 radiological release. That would be my general
10 understanding.

11 Q. So without going into the precise
12 definition, which I assume you recognize would be
13 stated in the regulations for the NRC --

14 A. Yes.

15 Q. -- you understand that an SSE is that
16 earthquake which is related to the potential for
17 systems, structures and components important to
18 safety not being able to perform their intended
19 safety function?

20 A. Yes. I've seen that general
21 description.

22 Q. And, therefore, if an earthquake exceeds
23 the SSE, then there's a potential that the safety
24 function of those SSCs may be impaired, correct?

25 A. Yes.

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1 Q. And therefore, the definition of an SSE
2 is important in order to understand at what level
3 an earthquake should be considered to be the design
4 earthquake in order to prevent the potential
5 release of radiological material or other hazardous
6 condition at the reactor?

7 A. Yes.

8 Q. You understand, then, that the SSE is
9 related to radiological risk?

10 A. Yes.

11 Q. In the next sentence, in that first
12 bulleted paragraph, it states, "In this case the
13 plant is assumed to have a predefined seismic
14 capacity as represented in terms of a core damage
15 fragility curve."

16 Do you see that sentence?

17 A. Yes, I do.

18 Q. Do you understand what is a core damage
19 fragility curve?

20 A. I have seen examples of fragility curves
21 included in NUREG 6728, either as a probability
22 density function or a -- more generally a
23 cumulative distribution function.

24 Q. Are you familiar with the X and Y axes
25 that would be represented in a chart depicting a

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1 fragility curve?

2 A. The Y axis would be probability, the X
3 axis, capacity.

4 Q. And probability of what?

5 A. The probability of failure, however
6 defined. Presumably the failure of the component
7 to perform its function.

8 Q. And when we're speaking about the
9 ability of a component to perform its function,
10 we're talking about its ability to perform the
11 intended safety function so as to protect the
12 public health and safety and avoid radiological
13 releases?

14 A. That seems reasonable, yes.

15 Q. Or possibly, if not a radiological
16 release, at least to prevent damage to the core
17 such that a hazardous condition may ensue?

18 A. Yes.

19 MS. CHANCELLOR: Your Honor, may I
20 interject? I've withheld objecting to this line of
21 questioning because I did ask Dr. Arabasz a
22 question about that circular reasoning in the
23 Staff's safety evaluation report dated December
24 15th, and Dr. Arabasz testified that this was of an
25 historical nature and was no longer valid. And I'm

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1 just wondering if this line of questioning is
2 relevant to anything that is at issue in this
3 contention.

4 JUDGE FARRAR: Mr. Turk?

5 MR. TURK: Your Honor, Ms. Chancellor
6 pursued this line of questioning. Dr. Arabasz, in
7 response to her questions, indicated his view that
8 Reg Guide 1.165 was not involved in consideration
9 of radiological risk. I indicated at the time that
10 he discussed the document my belief the document
11 should be excluded because he didn't appear to have
12 a proper understanding, or at least he hadn't
13 expressed a proper understanding. If
14 Ms. Chancellor had not raised the question in her
15 redirect, I would not be pursuing it now. Whether
16 it's relevant or not, I leave to Ms. Chancellor's
17 initial determination to ask the question in the
18 first place.

19 JUDGE FARRAR: I think he's largely
20 correct, Ms. Chancellor. I'll overrule the
21 objection.

22 MR. TURK: And I'd note again, Your
23 Honor, it is a difficult area, and I'd appreciate
24 the lack of interruption.

25 MS. CHANCELLOR: Your Honor, I object to

1 this characterization on the record.

2 JUDGE FARRAR: Wait, wait.

3 I thought, Mr. Turk, you were going to
4 say it's a difficult area and that's why sometimes
5 we're not sure we're within the scope of the prior
6 examination or not. But Ms. Chancellor's
7 objection, although not well founded substantively,
8 was fully appropriate to be lodged.

9 And so let's just move on.

10 Q. (By Mr. Turk) Dr. Arabasz, when you
11 provided your testimony yesterday, did you have
12 this Appendix C to the NEI paper in mind?

13 A. Yes, and I was viewing it in a different
14 context than how you are now parsing it.

15 Q. You recognize the fact that radiological
16 risk is a part of this reference?

17 A. It is -- yes, and it's part of the
18 consideration of what is described here as an
19 analytical assessment of seismic risk, which I
20 recognize in its exposition in pages not included
21 in the exhibit that you offer that expands in a
22 very similar way to the exposition of an approach
23 in methodology in the Kennedy and Short paper and
24 in NUREG 6728, Section 7.

25 MR. TURK: Your Honor, may we go off the

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1 record for a moment?

2 (A discussion was held off the record.)

3 Q. (By Mr. Turk) Dr. Arabasz, in your
4 testimony earlier today, I believe you mentioned
5 that -- with respect to the table that appears in
6 the Yucca Mountain Topical Report, State
7 Exhibit 202, I believe you indicated today that you
8 consider now that three of the plants listed in
9 that table --

10 A. Excuse me, Mr. Turk.

11 Q. Yes.

12 A. May I put this document away? Are
13 you --

14 Q. Yes, I'm completed with it.

15 A. Yes, I have it.

16 Q. State Exhibit 202 contains page C-18 of
17 Topical Report TR-003 for Yucca Mountain, correct?

18 A. Correct.

19 Q. Incidentally, I believe you referred to
20 this as the TR-2 document. Is that the colloquial
21 way to refer to this?

22 A. If I did, I may have been mistaken, but
23 I --

24 Q. Well, you may be correct, in fact. I
25 don't know if there's ever been a TR-1.

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1 A. A Topical Report 1, yes, there is.

2 Q. There has. All right.

3 A. Okay. So I'm sorry --

4 Q. All right. So --

5 A. -- Topical Report 2.

6 Q. Well, this -- this table appears in
7 Topical Report TR-003?

8 A. Correct.

9 Q. And I believe your testimony today
10 indicated that three of the facilities listed in
11 this table are associated -- or are western U.S.
12 plants associated with the coastal region, the
13 tectonic plate region?

14 A. In my belief, yes.

15 Q. And you're excluding from that the Palo
16 Verde and the Washington Nuclear Plant -- which of
17 the nuclear plants? Is it No. 3?

18 A. 2 is Hanford.

19 Q. And you're excluding that from your
20 discussion of coastal tectonic plate sites?

21 A. Yes.

22 Q. And you indicated your belief that there
23 is -- I believe you stated, quote, a dearth of
24 information for sites in the noncoastal United
25 States, close quote. Maybe I'm quoting you

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1 wrong --

2 A. Is this from May 17 or from --

3 Q. This was in this morning's examination.

4 I believe this was Mr. Gaukler's cross.

5 A. Are you reading from the transcript?

6 Q. No. I don't have a transcript yet.

7 A. All right. From your notes?

8 (A discussion was held off the record.)

9 MR. TURK: Oh, perhaps that was the
10 question, then.

11 Strike that, then. I withdraw that
12 question.

13 Q. In State Exhibit 203, that is the
14 exhibit in which you provide your hand
15 annotation --

16 A. Correct.

17 Q. -- for various western U.S. plant sites
18 or facility sites.

19 A. Correct.

20 Q. Can you provide us with information as
21 to the frequencies that you used in coming up with
22 the numbers that appear in your annotation on page
23 84 of that exhibit?

24 A. Yes. The average of ordinates for 5
25 hertz and 10 hertz or other information in that

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1 near range provided in Appendix C, if one reads
2 Appendix C carefully, it's evident that full data
3 and information are not provided for every nuclear
4 power plant, so assumptions are made by the authors
5 to get reasonable estimates. For example, there
6 might be data provided for, let's say, the 3- to
7 8-hertz range for a particular power plant, and if
8 that were the only data available to the authors of
9 the topical report, then they justify it and
10 explain and use that data as a best estimate.

11 Q. Can you identify for each of the five
12 facilities that you list there what frequencies you
13 realized?

14 A. Yes. I'll refer to my copy of the
15 topical report.

16 Q. So when you mentioned Appendix C, that's
17 Appendix C to Topical Report 003, correct?

18 A. Yes.

19 For San Onofre data are provided in
20 Table C-1 on page C-11, for spectral acceleration
21 at 10 hertz and 5 hertz for probabilities of 1E to
22 the minus 5, 1E to the minus 4, 1E to the minus 3.

23 Q. I'm sorry. Did you State Table C-1?

24 A. In my copy, yes, on page C-11 --

25 Q. Okay.

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1 A. -- in the table identified as table C-1.
2 This is for the San Onofre site.

3 Washington Nuclear Plant 2, I have
4 information on page C-12 where hazard spectra are
5 presented for -- excuse me, ordinates can be read
6 for 5 hertz and 10 hertz at the 1,000-year return
7 period and the 10,000-year return period. They're
8 not provided for the 100,000-year return period,
9 hence my simple line entry, my handwritten table.

10 Q. In other words, you left that as a
11 blank?

12 A. Correct. And recognizing that, by
13 comparison I could proceed up that column to the
14 Kennedy and Short entry for the Hanford site
15 insofar as WNP-2 was located on the Hanford
16 Reservation with some reasonable equivalents. In
17 other words, I did not -- I was unable to enter a
18 value for A5/A4 for the Washington Nuclear Plant 2
19 and have referred to the availability of
20 information for Hanford farther up in that column.

21 Q. That doesn't appear in your annotation?

22 A. No, it does not.

23 Q. Okay. By the way, I didn't mention
24 Washington Nuclear 3, Satsop. Is that the next one
25 you want to address?

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1 A. Yes, that and Palo Verde. And for Palo
2 Verde, on pages C-7 and C-8, hazard curves are
3 provided for 5 hertz spectral velocity and 10 hertz
4 spectral velocity. One can measure those ratios of
5 ground motion equivalently insofar as if one went
6 from spectral velocity to spectral acceleration,
7 you would simply multiply by 2 pi times the
8 frequency being used, and because it's a ratio,
9 those terms would cancel out.

10 And that leaves Washington Nuclear Plant
11 3, I believe, and for Washington Nuclear Plant 3 I
12 used information on page 16 where it has a curve
13 given for spectral velocity. In this case it's for
14 .15 seconds, which would be a frequency of between
15 6 to 7 hertz.

16 Q. When you say approximately between 6 and
17 7, is it about 6.67? I'm sorry. I don't have my
18 calculator out.

19 A. Yes, 6.67. And I believe that covers
20 the -- the range of information that comes from the
21 Topical Report 2.

22 Q. I don't see in this table, State
23 Exhibit 203, any calculation for the PFS site. Did
24 you attempt to determine the A5 over A4 or the A4
25 over A3 for the PFS site?

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1 A. The A4 over A3 was calculated by
2 Dr. Cornell, or at least reported in Attachment A
3 to his prefiled appendix in terms of the kH value
4 which he reports as 2.8, to the best of my memory,
5 so that if one took 2.8 and its inverse and then
6 its inverse log, one would have an A4/A3 value for
7 the PFS site of 2.28.

8 Q. And would you accept that as a correct
9 number?

10 A. Yes.

11 Q. And what about for an A5 over A4?

12 A. The A5 over A4, using the same figure in
13 the Geomatrix report from which Dr. Cornell made
14 his measurements, there's some difficulty in that
15 the 10 to the 5th value is slightly off the
16 right-hand side of the graph and it's not clear
17 what the resolution of the data points controlling
18 that graph is. To the best of my memory, I made an
19 approximation of an A5/A4 value that was of the
20 order of 1.8. And, again, this is just from
21 memory.

22 Q. 1.8?

23 A. 1.8.

24 Q. Incidentally, the values that you
25 mentioned for the PFS site, is that the soil

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1 condition or the rock condition? Maybe I'm using
2 the wrong term. Do you recognize from
3 Dr. Stamatakos's chart that he provided two curves,
4 one for the soils and one for the rock?

5 A. I believe in Dr. Cornell's attachment
6 it's a Figure 6-11, and -- I'm not certain. I
7 believe that it was the PGA hazard curve for the
8 soil conditions, to the best of my memory.

9 MR. TURK: Your Honor, this is an area
10 that I would turn to Dr. Stamatakos to examine
11 upon, but I'd like to wait at this time and
12 complete my examination so we don't do tag team.
13 I'll complete what I'd like to ask, and then I'll
14 ask Dr. Stamatakos to pursue this line further.

15 JUDGE FARRAR: All right. We don't mind
16 -- if you're on a line now and you want him to
17 continue, we're happy to do that, and then you come
18 back to another subject.

19 MR. TURK: As long as that's not going
20 to be objectionable to anybody, that's okay with
21 us.

22 JUDGE FARRAR: I think the concern is
23 that he would ask a question and you would ask a
24 follow-up on the same subject.

25 Any objection to the procedure?

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1 MS. CHANCELLOR: No objection, Your
2 Honor.

3 JUDGE FARRAR: Dr. Stamatakos, I don't
4 know how often this provision of the regulations
5 has been invoked, but give it a try.

6 DR. STAMATAKOS: This is clearly a first
7 for me.

8 MR. TURK: We've made a deal. After
9 today, he'll go to law school and I'll try to learn
10 something about geophysics.

11
12 RECROSS-EXAMINATION

13 BY MR. STAMATAKOS:

14 Q. Good afternoon, Dr. Arabasz.

15 A. Good afternoon, Dr. Stamatakos. And I
16 assume you're now on lawyer's rates.

17 Q. I think the only thing I'll get out of
18 it, I might get a free dinner out it.

19 We had a lot of discussion about the
20 implications of the different slopes of these
21 hazard curves or their AR values, but I wonder if
22 you might venture what your opinion is of the
23 underlying phenomenon which contribute to the slope
24 of the -- the differences in the slopes of these
25 hazard curves that you talked about.

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1 A. Yes. I believe it's basically due to
2 the proximity of a controlling fault in the
3 western, let's say, plate boundary area, which has
4 a relatively short return period, on the order of
5 centuries, as opposed to seismic sources moving
6 farther eastward that have much longer recurrence
7 intervals such that as you advance to the right on
8 the hazard curve to ground motion, in the western
9 U.S., after the controlling faults have produced
10 their maximum motions, the additional ground motion
11 going to the right on a hazard curve is basically
12 coming from a -- I believe a tail on the
13 distribution of ground motion, let's say on an
14 attenuation curve, the log normal distribution of
15 ground motion given a particular distance and
16 magnitude, whereas on the eastern United States, as
17 you move to the right or as you come down a decade
18 in probability or return period that you still are
19 having larger earthquakes from new sources with
20 very long return periods that weren't contributing,
21 as it were, one decade up in probability on the
22 hazard curve, so that if we looked at this ski jump
23 or ski slope that I described, as we're moving down
24 in probability -- excuse me -- correct, as we're
25 moving down on the Y axis in probability, in other

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1 words, as we are encountering time with longer
2 recurrence -- excuse me, longer return periods
3 between events, that we're encountering large
4 earthquakes in the central and eastern United
5 States that have very, very long return periods.

6 I think that's the general gist of why
7 these curves are flatter at the lower probabilities
8 in the central and eastern United States and,
9 relatively, in the intermountain area compared to
10 the plate boundary.

11 Q. Do you -- in addition to that, would you
12 agree that some component of the slope reflects
13 uncertainties in the probabilistic seismic hazard
14 assessment itself? You mentioned the ground motion
15 part and when you get to the tails of the
16 distributions, does that uncertainty also play a
17 role, do you think, in the shape of the slope of
18 the hazard curve?

19 A. Yes, but in some way that I couldn't
20 fully understand. I come back to this comment that
21 you picked up on many mickle makes a muckle, and it
22 really takes a trained analyst to understand all of
23 the aspects of a hazard curve and understanding
24 elements that contribute to level or shape.

25 Q. Are you aware that in the assessment

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1 that was performed for Diablo Canyon, for example,
2 that there was some specific discussion about how
3 the uncertainty was modeled in the ground motion
4 part with an effort towards achieving some
5 character to the slope in the Diablo Canyon hazard
6 curve?

7 A. I'm not familiar with that.

8 Q. You -- you gave us some additional
9 numbers for the PFS site. I wonder if you could go
10 back -- I see a discrepancy or an apparent
11 discrepancy. I wonder if you could check it for
12 me. For the Los Alamos -- you provided in one of
13 the State's exhibits some hazard information for
14 Los Alamos, and I did a quick calculation -- I
15 wonder if you could do the same -- of what the
16 slope value was for Los Alamos. That's State
17 Exhibit 206.

18 A. Okay. I did not attempt a slope value
19 because Kennedy and Short had entered one for Los
20 Alamos on Table A-2.

21 Q. Could you do one quickly now, just to
22 check against the values that they reported?

23 A. Okay. I'll use information from the
24 1,000-year equal hazard spectrum and the
25 10,000-year equal hazard spectrum.

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1 Okay. On the -- looking at Figure 9-98,
2 and I will enter on the Y axis at .2 seconds for
3 5 hertz, and I will read approximately 1.43 for the
4 spectral acceleration for the 10,000-year value.
5 And for the 1,000-year value, which will be the
6 second curve from the bottom, the lowermost one
7 being 500 years and then 1,000 years, I'll read a
8 value of approximately .51. And this will be the
9 A4/A3 value.

10 Q. A4/A3 or A -- you're right, excuse me,
11 A4/A3. You're correct.

12 A. So I will have a ratio of 1.53 to .51.

13 MR. TURK: 1.43.

14 THE WITNESS: Excuse me. 1.43 divided
15 by .51 and a value of 2.80, and that -- well, yes,
16 that's my estimate for -- for 5 hertz. And, let's
17 see. So we'll enter the X axis for .1 seconds,
18 representing the 10 hertz ordinate. On the
19 uppermost curve for the 10,000-year spectrum, I
20 will read a value of 1.1 g. On the 1,000-year
21 hazard spectral curve, I will read a value of
22 approximately .41. And my ratio will be 1.1 g
23 divided by .41 g, giving me 2.68. And then I will
24 average the 2.8 plus the 2.68 and have a result of
25 2.74, or approximately 2.7, to two significant

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1 figures.

2 Q. (By Dr. Stamatakos) And can you compare
3 that to the value that was reported in the Kennedy
4 and Short paper for Los Alamos?

5 A. Yes. This is an A4/A3 value. Kennedy
6 and Short -- excuse me, Kennedy and Short for the
7 site LANL report a value of 2.14.

8 Q. So there's some -- some noticed
9 difference between the values we calculated here
10 and the values that are reported in that paper?

11 A. Yes. And I will remind you of a caveat
12 I made this morning, that I wasn't attempting to
13 definitively solve the problem, but I was seeking
14 qualitative information to try to flesh out my
15 overview of the western U.S. moving eastward from
16 the plate boundary.

17 Q. I appreciate that.

18 Given that, which value would you
19 consider to be more representative in your sort of
20 overall assessment, the 2.14 as reported in the
21 Kennedy and Short paper or the calculated value you
22 just performed for us here?

23 A. The caution presented by Kennedy and
24 Short in their analysis is to take care to use
25 hazard curves in some wording that related to their

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1 pedigree, and so in this case we have a February
2 1995 report for an updated P-S-H-A done at the Los
3 Alamos site done by Woodward-Clyde, then, and which
4 would be given precedence, in my opinion.

5 Q. In other words, the 2.7 is a more
6 accurate representation of the A sub R for Los
7 Alamos?

8 A. A4/A3. That would be the preferred
9 value, in my opinion.

10 Q. One last one. Did you attempt to
11 calculate an AR ratio for the National -- the USGS,
12 the NEHRP curve that I provided in that scientific
13 notebook exhibit that had the family of hazard
14 curves for the western United States?

15 A. No, I did not.

16 Q. Can you just take a quick look at that
17 figure, if you can find it?

18 MR. TURK: It's Staff Exhibit JJ at page
19 5 of the scientific notebook.

20 Q. (By Mr. Stamatakos) Would it be fair to
21 venture an estimate that that slope of that hazard
22 curve is steeper than the hazard curves for Skull
23 Valley, either the rock hazard curve or the --

24 A. Which curve are you referring to?

25 Q. The curve in red -- oh, I'm sorry. It's

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1 the one that's labeled Salt Lake City. Of course,
2 you don't have the color version.

3 MS. CHANCELLOR: Does the exhibit that
4 Dr. Arabasz has have the pedigree of the data?

5 THE WITNESS: It's a hazard curve that
6 would be more generalized because it would not
7 involve as fine scale seismic source
8 characterization as some of these other curves.

9 Q. (By Mr. Stamatakos) But just on the
10 shape of that curve, given that figure, it would
11 appear to be slightly steeper than the hazard
12 curves for PFS; is that correct?

13 MS. CHANCELLOR: Is this a hypothetical
14 question based on the graph on page 5 of Staff's
15 Exhibit JJ?

16 MR. TURK: Your Honor, may I interject?
17 As an attorney, the question was does the line for
18 Salt Lake City appear to be steeper than the lines
19 for PFS. I don't hear a hypothetical.

20 MS. CHANCELLOR: And Dr. Arabasz
21 testified that the --

22 MR. TURK: I don't think the question
23 has a --

24 MS. CHANCELLOR: Just let me finish.

25 -- that the value -- that A sub R

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1 value -- that the validity of that value is based
2 on the pedigree of the data, and so my question is
3 is it a hypothetical question because, first of
4 all, you have to -- I don't want to get into
5 technical legal objections with Dr. Stamatakos, but
6 there really is no foundation that the Salt Lake
7 City curve actually represents any particular site
8 in Salt Lake City.

9 Q. (By Mr. Stamatakos) I would just say on
10 the face value of the curve, just based on the
11 shape of that particular curve as represented. So
12 I don't know if that's hypothetical or not but --

13 A. Well posed, Dr. Stamatakos.

14 MR. TURK: I think the lawyers should
15 just leave the room.

16 THE WITNESS: What I have to accept
17 here, we have a composite plot, whereas with the
18 other plots what I was accessing were -- were
19 detailed hazard curves where the author is -- would
20 be validating with great specificity, you know, the
21 accuracy of the plotting points and so on. Here I
22 have a generalized plot. I would have to accept
23 your representation of the accuracy of this curve,
24 as you've transcribed it from the NEHRP database to
25 this plot. And as you gave me the hypothetical, at

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1 face value, we will compare in the probability
2 interval 10 to the minus 3 to 10 to the minus 4,
3 the red line on the figure that I have with which
4 plot from Skull Valley?

5 Q. Either the soil curve or the rock curve.

6 A. And, let's see. In that interval -- I
7 need to be careful with slopes here. Yes, there is
8 an apparently steeper slope in log normal space,
9 and I would have to -- to make a quick calculation
10 to -- well, let's see. Okay. The process,
11 recognize, please, involves a ratio, so to get to
12 that ratio in the -- the A4/A3 value, I need to
13 make a quick calculation.

14 Q. Okay. Go ahead.

15 A. Well, I must have made my calculation
16 too quickly because I got 2.23 -- excuse me, 2.3
17 versus 2.25.

18 I believe the implication is that the --
19 what appears to be the shallower dipping slope, in
20 this case the hazard curve for Skull Valley, will
21 end up with a larger AR value than the one for Salt
22 Lake City.

23 Q. Thanks for on-the-spot calculations.

24 I wonder if I could ask you to look at
25 DOE-STD-1020, Appendix C, again, and I believe this

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1 is Staff Exhibit QQ. And if you could, turn to
2 page C-9.

3 A. I have it.

4 Q. There's a paragraph in the middle of the
5 page that begins with the words, "The Basis of the
6 Seismic Provisions of DOE-1020."

7 Do you see that?

8 A. Yes, I do.

9 Q. Halfway down in that paragraph I believe
10 the authors of this document offer a definition of
11 what they mean by tectonic plate boundaries,
12 beginning with the words, "For California and other
13 high seismic sites near tectonic plate." Would you
14 mind reading that full definition?

15 A. "For California and other high seismic
16 sites near tectonic plate boundaries with
17 seismicity dominated by close active faults with
18 high recurrence rates, AR typically ranges from 1.5
19 to 2.25. If other western sites with seismicity
20 not dominated by close active faults with high
21 recurrence rates such as INEL, LANL, and Hanford,
22 AR typically ranges from 1.75 to 3.0. Therefore,
23 seismic design/evaluation criteria should be
24 applicable over the range of A sub R from 1.5 to 6
25 with emphasis on the range from 2 to 4."

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1 Q. Thank you.

2 Let's look at that definition with an
3 eye towards the hazard that Geomatrix produced for
4 Skull Valley. Would you agree with me that the
5 site at Skull Valley is close to active faults?

6 A. Yes, I would.

7 Q. Would you agree that -- as calculated,
8 that the seismic hazard for the site is high
9 seismicity?

10 A. No.

11 Q. And then can you give me a definition of
12 what you would mean by high seismicity?

13 A. If we look at the regional source areas
14 defined by Geomatrix in their analysis of
15 seismicity in the central Utah region, I recall
16 three source zones. I can't remember how they were
17 depicted, but there basically was a zone which
18 encompassed the PFS site which was westward of a
19 zone of higher background seismicity in the general
20 north central Utah region. And on that basis, just
21 from memory, what I would characterize is that in
22 the vicinity of the PFS site, marginal to the main
23 seismic belt, that the seismicity was less than the
24 seismicity along the central zone which encompassed
25 and was more or less centered on the Wasatch Fault

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1 zone.

2 Q. So your definition occurs to the rate of
3 occurrence in historic earthquakes and not to the
4 overall level of ground motion you might expect at
5 the site?

6 A. That was the response that I gave you.

7 And one thing that -- that concerns me
8 as a seismologist, when I enter this exercise and
9 go to the step or consider the step of calculating
10 the recurrence ratios, in other words, using the
11 kind of equation that Dr. Cornell did in Attachment
12 A of his prefiled testimony, that it's not evident
13 to me, as a nonengineer, when I end up with a -- a
14 risk ratio whether that reflects a relationship to
15 an average capacity, to a critical capacity of some
16 component. And so I take care, assuming that
17 there's some considerable engineering judgment
18 entering in looking at that special segregation of
19 outcomes that are identified by Kennedy and Short
20 as being near the tectonic plate boundaries, in
21 justifying the lower return period, P sub H value.

22 Q. All right. I think you went way beyond
23 what I was asking you on that --

24 A. You've been patient. Mr. Turk would not
25 have allowed me.

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1 JUDGE FARRAR: Speaking of patience, we
2 had talked about going to 3:30. If you have more
3 than a couple minutes, Dr. Stamatakos, it might be
4 worth taking a break.

5 MR. STAMATAKOS: Let's take a break. I
6 have just a couple more question on this and one
7 other --

8 MR. TURK: I would caution the
9 questioner not to limit the number of questions.

10 JUDGE FARRAR: Right.

11 MR. TURK: I've done that.

12 JUDGE FARRAR: It's quarter of. We've
13 lost some time today due to unforeseen
14 circumstances, so let's just take 10 minutes, be
15 back at 5 of.

16 (A recess was taken.)

17 Q. (By Mr. Stamatakos) Dr. Arabasz, a
18 minute ago I asked you about -- we had a little
19 discussion about what you consider high seismicity,
20 and you indicated that you didn't think that the
21 PFS site necessarily lies within an area of that
22 high seismicity. Given that, aren't you at least
23 surprised of the very large ground motions that
24 Geomatrix predicted at this site, given some
25 absence of what you would classify as high

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1 seismicity, especially in comparing those ground
2 motions with some of the ground motions that are
3 calculated for sites that are clearly on the
4 tectonic margin in areas I would assume you would
5 say have high seismicity like Diablo Canyon or the
6 San Francisco Bay Bridge?

7 A. Recognize that the slope of the hazard
8 curve is different at the PFS site, and what is
9 controlling the ground motion as described in the
10 Geomatrix report are earthquakes of approximately
11 magnitude 6.5 that have been brought very close to
12 the site that are at distances, as I recall, on the
13 order of 5 kilometers. And given the closeness of
14 the controlling earthquake source to that site, the
15 east fault, for example, having a distance of less
16 than 1 kilometer from the measuring point on the
17 site that Geomatrix selected, I reckon that that's
18 the consequence of bringing that source so close to
19 the site.

20 Q. All right. A little while ago we gave
21 some estimates of the ratios, those A ratios, for
22 the PFS curve. I think you quoted Dr. Cornell
23 having an A4 to A3 curve ratio of 2.28, and you
24 recalled the A5 to A4 ratio to be something around
25 1.8 --

1 A. Let me just check that. Let's see, the
2 conversion to -- from 2.8, that sounds right, but
3 let me just check that quickly.

4 Yes. Okay.

5 Q. So if you go back and look at that
6 definition in the DOE-STD-1020 on page C-9, with
7 those kinds of AR ratios, you would agree with me
8 that they could fall into the category that are
9 defined here either for the high seismic tectonic
10 plate or the range that are given for other western
11 sites not dominated with close faults with high
12 recurrence rates?

13 A. Two aspects of this. Numerically I
14 think we may be dealing with the A4/A5 range with a
15 borderline value, something borderline in terms of
16 an implication for a risk reduction ratio
17 considered in the B.4 category in the DOE table.
18 But, in a general setting, let's say on regional
19 scale, from the discussion that Dr. Cornell gave
20 relating to hazard in California along the plate
21 boundary and Salt Lake City in general, the
22 difference in implication for hazard on a regional
23 scale is distinctly different.

24 Q. But just the values in and of
25 themselves, given the value distinctions that are

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1 provided in the document, the 1.8 or 2.28 could
2 fall within the range of 1.5, 2.25 or 1.7 to 3.0
3 which are given in the definition in the DOE
4 standard, correct?

5 A. Correct. There are a spectrum of
6 values, and Kennedy and Short selected, as I
7 recall, what were overlapping ranges for their --
8 let me return again to page C-9 that you pointed me
9 to. The plate boundary curves 1.5 to 2.25
10 overlapping with the next range, 1.75 to 3.0
11 overlapping with the -- let's see the range for
12 the -- I'm searching for the central and eastern
13 U.S. But each of those classes has overlapping
14 bounds.

15 Q. So perhaps a more refined way of
16 thinking about these different classes of areas,
17 following the logic at least as it's presented
18 based on DOE-1020, might perhaps be that we
19 shouldn't have two distinctions but perhaps three
20 distinctions, the central and eastern United States
21 where the slopes are very shallow and the
22 recurrence intervals are very long, an
23 intermountain west division and a tectonic plate
24 division. Would you agree with that assessment?

25 A. No, and I'll explain why. This is

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1 something that earth scientists might dream up as a
2 logical way to bend the information, and I think a
3 better, a more refined way to -- to look at the
4 issue is the more complete methodology that's
5 developed in NUREG 6728, particularly in Section 7.
6 That entire NUREG faces the issue of aiming for
7 risk consistency across the whole country and how
8 to deal with that problem. And what that poses is
9 a need for extensive regulatory development to
10 treat all of this information, the earth science
11 input, namely, the hazard curves, notably their
12 slopes and their influence on seismic margin
13 studies and capacities, design or evaluation
14 procedures, acceptance criteria and so on that gets
15 into that engineering domain that I'm reluctant to
16 step into.

17 Q. But -- so given that criticism, then,
18 you would also be critical of this current division
19 that's just provided in DOE-1020 between the
20 tectonic plate and the rest of the country,
21 following that same logic, correct?

22 A. I'll take care with the criticism
23 because I would have to stand back. And I have a
24 considerable respect for Dr. Kennedy as he's
25 developed this methodology, and I recognize from

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1 various sources that it appears he's had a very
2 heavy influence in the development of this
3 methodology and particularly in its application.
4 Now, when I consider the DOE facilities to which
5 these results are applied, it's very clear that
6 these are major, major installations, particularly
7 the litany of installations across the western
8 U.S., and my belief would be that very serious
9 considerations and lots of engineering judgment
10 went into the development of that methodology and
11 its application, particularly for the DOE
12 facilities.

13 Q. So if I understand that correctly -- I
14 make a leap of logic here -- then this whole
15 exercise where we're looking at the AR and the
16 slope values is not as critical as other aspects,
17 in your assessment? In fact, perhaps this slope --
18 at least the details of the slope calculations
19 don't really matter all that much compared to other
20 parts of your -- your logic.

21 A. They're very important in an equation
22 that appears in Attachment A of Dr. Cornell's
23 prefiled testimony, and that equation also appears
24 in NUREG 6728 and even going back to this Reference
25 B.4 cited in the Reg Guide 1.165. The slopes of

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1 those hazard curves are a big deal to the engineers
2 insofar as those slopes propagate through
3 considerations of factors of safety into risk
4 consistency. And so what we have going, all the
5 way back to that paper submitted by the Nuclear
6 Energy Institute, is great concern about along the
7 plate boundary having failures of probability
8 lower -- let me see. No, excuse me -- failures of
9 probability, lower -- yes, I believe I have that
10 correct -- compared to nuclear facilities in the
11 eastern and central United States.

12 Q. Take one more example, and I think I'll
13 be able to wrap up. If you look at the AR value
14 for Washington Nuclear Plant No. 2 that you
15 calculated in State Exhibit 203, that value is
16 2.72, correct?

17 A. For the A4/A3, and that would apply to a
18 PC-3 facility.

19 Q. And we don't know what the value is for
20 A5 to A4?

21 A. We would have to accept the value
22 entered for Hanford by Kennedy and Short under the
23 A4/A5 column and accept that the -- because the
24 Nuclear Power Plant 2 is on the Hanford
25 Reservation, that the hazard curves might be

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1 similar.

2 Q. If you look at those slope values -- and
3 I know in the discussion when we were talking about
4 these five particular power plants you sited Palo
5 Verde as being an outlier. I wonder if you might
6 also consider that perhaps Washington Nuclear Power
7 Plant 2 might be an oddity in the sense that it has
8 relatively high slope values but its SSE or its
9 mean probability of exceedance that corresponds to
10 the SSE is about 3,600 years and so, in a sense, it
11 doesn't fit the definition of having an SSE that's
12 closer to 10 to the minus 4 acting like a site that
13 should be in the eastern central U.S. bin as
14 opposed to the tectonic plate bin, correct?

15 A. Correct, and I applaud you, as a
16 scientist, for honing in on the exception because
17 generally there's information to be gathered there.
18 I believe that at the beginning of your
19 characterization you said that the site -- the
20 Washington Nuclear Plant 2 had a high slope --

21 Q. I mean a high AR value, excuse me,
22 higher than you might expect.

23 A. The value of 2.01 --

24 Q. Or higher up, 2.72.

25 A. Yes, a higher AR value, correct. Okay.

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1 Now I'm with you.

2 A real puzzle why that exceedance
3 probability for the Washington Nuclear Power Plant
4 in terms of the return period is so low, and one
5 possibility is that the original design basis
6 earthquake, for whatever reason, may be low, lower
7 than one would expect at that site.

8 Q. So you at least would want to critically
9 question how that SSE was originally derived?

10 A. Just so, particularly if I were to go to
11 a table in Yucca Mountain Report 2 and use that as
12 a basis for attempting to justify the 5,000-year
13 return period for the entire western U.S., that
14 point certainly would invite close inspection.

15 Q. But that's -- that conclusion you draw
16 is based on this whole line of thinking about
17 slopes and locations relative to tectonic margins
18 and where these facilities ought to be compared to
19 the type of exceedance probability you would expect
20 for their SSE?

21 A. In general, yes. I think I followed
22 your question adequately.

23 MR. STAMATAKOS: I don't think I have
24 any --

25 (A discussion was held off the record.)

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1 MR. STAMATAKOS: I thank everybody's
2 indulgence for a non-lawyer being able to ask
3 questions, and I hope I never have to do this
4 again.

5 JUDGE FARRAR: Thank you,
6 Dr. Stamatakos. We appreciate your contribution.

7 Mr. Turk, you wanted to go to another
8 line?

9 MR. TURK: Yes, Your Honor.

10 JUDGE FARRAR: All right.

11 MR. TURK: And I would note I would also
12 thank Dr. Stamatakos. I thought it was very
13 helpful and done professionally, as an attorney
14 would do in his best practice.

15

16 RECROSS-EXAMINATION (Continued)

17 BY MR. TURK:

18 Q. One thing that you mentioned in your
19 testimony earlier today, Dr. Arabasz, was you
20 looked at the set of curves presented by
21 Dr. Stamatakos in Exhibit JJ for the Staff at page
22 5, you mentioned that this was done with a
23 logarithmic Y axis and an arithmetic X axis, and
24 would you agree that that's a proper way in which
25 to present the information contained in this graph?

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1 A. I think it's an arbitrary presentation.
2 The hazard could either be -- excuse me. The
3 hazard curve could either be presented in log-log
4 space or log normal, and data are presented in
5 either format.

6 Q. When you say "arbitrary," what you're
7 saying, in essence, is that this is one acceptable
8 means in which to do it?

9 A. Correct.

10 Q. And you don't have any problem with the
11 fact that Dr. Stamatakos presented it in this
12 fashion?

13 A. No, I do not.

14 Q. Just so I'm clear in my understanding of
15 State Exhibit 204, which is the Update of
16 Deterministic Ground Motion Assessments, Revision
17 1, for the PFS site --

18 A. Yes, I have it.

19 Q. -- these curves do not purport to be,
20 nor are they, probabilistic seismic hazard analysis
21 -- seismic hazard curves, are they? These are only
22 deterministic curves.

23 A. No, that's not correct, Mr. Turk. The
24 solid line is a deterministic response spectrum
25 from the east fault, and that solid line is

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1 superposed (sic) on top of a series of curves
2 identified as equal hazard spectra that come from
3 the P-S-H-A.

4 Q. Do you understand that the equal hazard
5 spectra curves do not constitute new curves, but,
6 rather, this is a comparison of the deterministic
7 curve calculated by Geomatrix with those equal
8 hazard spectrum that existed previously, or are
9 those new curves?

10 A. In this -- in this Revision 1 of April
11 2001, the equal hazard spectra would come from the
12 latest P-S-H-A results at the -- at the PFS site,
13 or for the PFS site.

14 Q. And do you know when that latest P-S-H-A
15 was conducted? Is that the one we've been
16 discussing already in the proceeding?

17 A. Yes, in general reported in the March to
18 April 2001 time frame, as I recall, at least in the
19 documents.

20 Q. So these do not constitute new curves
21 with respect to the P-S-H-A, but, rather, this is
22 just a comparison of this deterministic line with
23 the probabilistic seismic hazard analysis curves
24 that are already -- that already make up part of
25 the PFS application and Staff review of that?

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1 A. In their most recent, most updated
2 version, correct.

3 Q. And the P-S-H-A curves, or as they're
4 described here, the equal hazard spectra curves,
5 those are not curves for the entire P-S-H-A, but,
6 rather, these are only the curves presented for
7 that particular fault, the east fault, correct?

8 A. No, that's not correct, Mr. Turk.

9 Q. So the equal hazard spectra, that
10 represents the entire P-S-H-A --

11 A. They are representations of the P-S-H-A
12 results.

13 Q. Including all faults applicable to the
14 site?

15 A. All seismic sources that enter into the
16 P-S-H-A, correct.

17 Q. At one point in your testimony earlier
18 today, you indicated that DOE chose not to use a
19 5,000-year return period but instead chose to use a
20 10,000-year return period. Do you recall that part
21 of your testimony?

22 A. Relating to Yucca Mountain?

23 Q. I believe it was for the -- the Yucca
24 Mountain preclosure facility.

25 A. Correct.

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1 Q. And in making that statement, were you
2 referring to something that appears explicitly in a
3 DOE document?

4 A. The -- yes, within the general context
5 of Yucca Mountain Topical Report 2 and DOE's
6 undertaking to identify and justify a probability
7 of exceedance for Frequency Class 2 events.

8 Q. Did you mean to suggest that DOE was not
9 aware of any intermountain characteristics that
10 might be applicable to the Yucca Mountain
11 preclosure facility?

12 A. Good Lord, no. What I'm suggesting is
13 that in developing Topical Report 2 that PFS --
14 excuse me. I've misspoken -- that DOE needed to
15 justify the selection of a hazard exceedance
16 probability for Frequency Class 2 events, selected
17 1 times 10 to the minus 4 and then, to justify that
18 selection, set out to compare it to a reference
19 probability for a nuclear power reactor and, as
20 part of that exercise, then carried out the hazard
21 exceedance -- excuse me, the -- the calculations
22 which computed the annual probability of exceeding
23 the SSE design basis response spectra motions for
24 existing nuclear power plants in the western United
25 States, at the end of that exercise basically had

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1 that result of a mean annual probability of
2 exceedance of 5 times 10 to the minus 4 and
3 logically would have had the option to either use
4 that as a reason for justifying a different
5 probability of exceedance or to remain with the 1
6 times 10 to the minus 4. And to my understanding,
7 they did the latter.

8 Q. And that afforded them additional
9 conservatism in establishing the design basis
10 earthquake for the facility?

11 A. That's correct.

12 Q. And, again, the preclosure facility --

13 MS. CHANCELLOR: Your Honor, I think
14 Dr. Arabasz may have misspoken.

15 Did you mean 2 times 10 to the minus 4
16 when you were talking about the western U.S.
17 nuclear power plants? I think you said 5 times 10
18 to the minus 4.

19 THE WITNESS: If I said 5, I misspoke.
20 I meant to say 2 times 10 to the minus 4.

21 MS. CHANCELLOR: Excuse me, Mr. Turk. I
22 didn't mean to interrupt.

23 THE WITNESS: That's the trouble I get
24 into when I lose my cheat sheet.

25 Q. (By Mr. Turk) And for clarity, you

1 mentioned that this is Topical Report 2. In fact,
2 that's TR-003, correct?

3 A. That's correct.

4 Q. And your confusion is one that I
5 understand other people make as well because these
6 reports are referred to colloquially differently
7 than they're titled.

8 A. Yes. And we encountered this is the
9 2001 depositions.

10 Q. And just so we're clear on the record,
11 then the preclosure facility includes the removal
12 of spent fuel from within canisters and the
13 transfer of that spent fuel into other storage
14 systems, correct?

15 A. Correct.

16 Q. And that's a higher hazard than would be
17 presented by the PFS facility in which -- I'm
18 sorry. There's a higher risk associated with that
19 than there is associated with the PFS facility in
20 which the spent fuel remains within the
21 multipurpose canister at all times, correct?

22 A. Correct.

23 Q. Do you have a copy of State Exhibit 203
24 handy?

25 A. This is the one with my hand

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1 annotations?

2 MS. CHANCELLOR: 203, Dr. Arabasz, is
3 the Kennedy and Short paper.

4 THE WITNESS: Yes, I have that in front
5 of me, Mr. Turk.

6 MR. TURK: May we have just a moment,
7 Your Honor?

8 (A discussion was held off the record.)

9 MR. TURK: I'll move on. I'll skip
10 that.

11 Q. At many different times in your
12 testimony you were discussing a document which I
13 believe you referred to as NUREG/CR -- is it 5628?
14 I'm sorry. 6 -- 6728?

15 A. Correct.

16 Q. Do you have that document with you?

17 A. Yes, I do. I have Volume 2 with me.

18 Q. And does that volume that you have with
19 you indicate who the authors of the document are?

20 A. On the --

21 Q. Or which organization sponsored it?

22 A. Yes. At least on the title page of
23 Volume 2, the authors are identified as Risk
24 Engineering Incorporated.

25 Q. And does it have the date?

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1 A. Excuse me. I also happen to have with
2 me a title page apparently from Volume 1 which has
3 additional information on authorship. Shall I hand
4 it to you to read into the record?

5 Q. No. If you would do that, it would be
6 more expeditious.

7 A. The title, Technical Basis for Revision
8 of Regulatory Guidance on Ground Motions: Hazard-
9 and Risk-Consistent Ground Motion Spectra
10 Guidelines. The date that appears, manuscript
11 completed May 2001. Date published, October 2001.
12 Prepared by R.K, McGuire, M-c-G-u-i-r-e, W.J.
13 Silva, C.J. Constantino with the affiliation of
14 Risk Engineering Incorporated being the principal
15 contractor. Subcontractor, Pacific Engineering &
16 Analysis. Consultant, Carl J. Constantino and,
17 identified, R.M. Kenneally, K-e-n-n-e-a-l-l-y, NRC
18 project manager.

19 Q. May I look at that now, please?

20 And at the bottom of the title page, do
21 you also see that it --

22 MS. CHANCELLOR: Mr. Turk, if you're
23 asking questions from Mr. Arabasz's document, could
24 you go and stand next to Dr. Arabasz, please?

25 MR. TURK: I think that's a fine idea.

1 Q. At the bottom of the cover page, do you
2 see that it states, Prepared for Division of
3 Engineering Technology, Office of Nuclear
4 Research, U.S. Nuclear Regulatory Commission?

5 A. Correct.

6 Q. Is it your understanding that this
7 document constitutes a publication by the NRC?

8 A. I'm uncertain. No. I infer or believe
9 that a NUREG is a publication which is given this
10 characterization or classification of some
11 recognition by the NRC.

12 Q. Do you understand if there's a
13 distinction between a document that bears a NUREG
14 designation versus a document that bears a NUREG/CR
15 designation?

16 A. I'm not familiar with that distinction,
17 Mr. Turk.

18 Q. Do you know whether the NRC staff or the
19 Commission has ever endorsed this document?

20 A. I do not.

21 Q. But as you look at the document, your
22 assumption is that this is an NRC approved
23 document?

24 A. An NRC sponsored and approved document.

25 Q. And if, in fact, it was not an NRC

1 approved document but, rather, represented the
2 views of the authors, including the contractors
3 listed there, then that would be something which
4 those authors or contractors purport to be valid,
5 but we don't know if the NRC agrees with that
6 conclusion, correct?

7 A. Correct. I understand that this is part
8 of a process of developing regulatory
9 considerations.

10 Q. And if, in fact, that document
11 represented the views of the authors or contractors
12 to the NRC, the fact that you agree with them, as
13 you've indicated in your testimony, would mean that
14 you like the views they have expressed there, you
15 would agree with the views expressed there and you
16 would believe that those views should be considered
17 by the NRC?

18 A. What I recognize in this document in the
19 methodology development is what I'll call the
20 fingerprint of Dr. Kennedy. His authorship is not
21 explicit in the Nuclear Energy Institute report,
22 the Reference B.4, but there's clearly a
23 commonality in looking at the Kennedy and Short
24 document, the methodology or the philosophy and
25 design approach in the DOE-STD-1020 documents.

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1 And, indeed, there are basic equations here that
2 are ascribed, for example, to development by
3 Gabriel El Toro and Dr. Cornell, in my
4 understanding and judgment representing the
5 considered opinion of very respectable
6 practitioners in the hazard and risk assessment.

7 Q. I'd like to move to another document at
8 this time, and that is a document that we've
9 admitted as a Staff exhibit, Staff Exhibit QQ,
10 which are portions of the DOE-1020-2002 standard.
11 And I would ask you to turn to page C-14 --

12 A. Excuse me. I seem to be missing that
13 one document.

14 Now I have it. Excuse me. Yes. Which
15 page, please?

16 Q. Starting at the bottom of page C-14 and
17 continuing on to page C-15, I think -- the
18 paragraph at the bottom of the page C-14, do you
19 see the discussion by DOE in which they indicate
20 that they have calculated the probability level of
21 SSE design spectra between 5 and 10 hertz at the 69
22 eastern nuclear power plants?

23 A. I see that.

24 Q. That's a bit different, isn't it, from
25 the previous discussion by DOE of only 29 nuclear

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1 power plants in the central and eastern United
2 States, correct?

3 A. Correct.

4 Q. Actually, there was a discussion in Reg
5 Guide 1.165 about 29 nuclear power plants in the
6 central and eastern United States.

7 A. Yes. There's a sequence of references.
8 It may have been Lawrence Livermore National Lab,
9 for example, that originally carried out that
10 analysis, and then the citation appears forward in
11 Reg Guide 1.165 and other places.

12 Q. If you turn to C-15 --

13 A. Yes.

14 Q. -- there's a chart. This is Figure C-4.
15 And is it correct that this chart represents a
16 plotting, p-l-o-t-t-i-n-g, of the probability of
17 exceeding safe shutdown earthquake response spectra
18 at those 69 central and eastern United States
19 nuclear power plants as a function of -- well, let
20 me stop there.

21 MS. CHANCELLOR: Your Honor, I've been
22 very patient. I just can't connect this up with
23 any redirect testimony.

24 MR. TURK: In his testimony earlier
25 today, Dr. Arabasz indicated he agrees with the 1

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1 times 10 to the minus 4 MAPE for nuclear power
2 plants, and I'm just examining on this document and
3 how that bears on his statement.

4 JUDGE FARRAR: All right. We'll allow
5 it, but it does seem to me that the recross is
6 going on a relatively long time compared to the
7 redirect. So --

8 MR. TURK: If it's any help, Your Honor,
9 I don't see very much more that I'm going to be
10 asking of him today.

11 JUDGE FARRAR: All right.

12 THE WITNESS: Yes, okay. Referring to
13 the graph, one of the typical differences between
14 graphs documented by engineers and those by
15 scientists, in general, is that the engineers
16 present a very terse title caption so that -- let's
17 see. I just -- I'm going to assume that, indeed,
18 the plot is for the 69 power plants and what we
19 have here is a cumulative distribution function.
20 And, let's see. I'm trying to discern whether
21 we're looking at the median -- I assume from the
22 value 1 times 10 to the minus 4 that these must be
23 mean exceedance values that were plotted, such that
24 the median of the means for the 69 power plants is
25 1 times 10 to the minus 4.

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1 Q. Just to make sure that there's no
2 confusion, at the bottom of page C-14 in that
3 paragraph that we discussed briefly --

4 A. Yes.

5 Q. -- if you would, read the sentence -- or
6 let me read it into the record. Quote, Recent
7 probabilistic hazard studies, e.g. Reference C-6,
8 have indicated that for nuclear plants in the
9 eastern U.S. the design SSE level generally
10 corresponds to an estimated annual frequency of
11 exceedance of between 0.1 times 10 to the minus 4
12 and 10 times 10 to the minus 4 as is illustrated in
13 Figure C-4. The probability level of SSE design
14 spectra between 5 and 10 hertz at the 69 eastern
15 U.S. nuclear power plants considered by Reference
16 C-6 fall within the above-stated range. Figure C-4
17 also demonstrates that for two-thirds of these
18 plants that the SSE spectra corresponds to
19 probabilities between about 0.4 times 10 to the
20 minus 4 and 2.5 times 10 to the minus 4. And then
21 it continues, Hence, the specified hazard
22 probability level of 1 times 10 to the minus 4 in
23 is this standard is consistent with SSE levels.
24 See also U.S NRC Regulatory Guide 1.165.

25 Does that help you with your

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1 understanding of what this figure is?

2 A. Yes.

3 Q. And it, in fact, does plot the 69
4 nuclear power plants in the central eastern United
5 States?

6 A. Yes.

7 Q. And could you tell me -- the vertical
8 access indicates or has a bar at the 0.5 level --

9 A. Yes.

10 Q. -- for cumulative distribution?

11 A. The Y axis is probability, so the
12 cumulative distribution as standardly plotted is
13 from 0 to 1. The horizontal line at .5 then would
14 represent the median, that value below which half
15 the entries fall and above which the remaining half
16 fall.

17 Q. So is it correct, then, that the
18 horizontal line represents a median value for those
19 69 nuclear power plants?

20 A. The intersection with the cumulative
21 distribution curve, which is the irregular curve,
22 that intersection -- well, let me look closer at
23 this because the intersection with the -- typically
24 one would intersect the curve and then go down to
25 intersect the X axis. In this case it appears that

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1 what is represented by the cross hairs, in effect,
2 is the value for 1 times 10 to the minus 4 on the X
3 axis, showing that, at least by my inspection, it
4 approximately intersects the cumulative
5 distribution function at the .5 level.

6 Q. In fact, it's slightly off from that.
7 Would it be more correct to say that the -- the
8 meeting of the means represented by the horizontal
9 line -- that's correct, that's a meeting of the
10 means?

11 A. Correct.

12 Q. -- comes out slightly to the right of
13 that 1 times 10 to the minus 4 value?

14 A. Correct.

15 Q. And can you take a look at that and give
16 me a rough estimation? Is that approximately a 1.1
17 times 10 to the minus 4 value?

18 A. A little less than 1.1. Something
19 between 1.0 and 1.1E to the minus 4.

20 Q. And that would equate to something of a
21 smaller return period than 10,000 years. That
22 would be more on the order of somewhere between
23 9,000 to 10,000 years?

24 A. Let me make a quick calculation.
25 9500, approximately.

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1 Q. Do you see much difference between
2 stating this value as being a 9500-year return
3 period versus a 10,000-year return period?

4 A. No. I think a careful practitioner
5 would characterize it as approximately 1 times 10
6 to the minus 4.

7 Q. The approximate equivalent?

8 A. Yes -- excuse me. Would characterize
9 the outcome, namely, the meeting of the means as
10 being approximately 1 times 10 to the minus 4.

11 MR. TURK: I have nothing further.

12 JUDGE FARRAR: Ms. Chancellor, do you
13 have some questions?

14 MS. CHANCELLOR: One, Your Honor.

15 JUDGE FARRAR: Okay. We'll see.

16

17 FURTHER REDIRECT EXAMINATION

18 BY MS. CHANCELLOR:

19 Q. Dr. Arabasz, did any of the questions
20 and testimony during Mr. Turk and Dr. Stamatakos's
21 recross-examination cause you to change the
22 opinions that you have given during this
23 proceeding?

24 A. I'll begin by pointing out that Mr. Turk
25 graciously helped me with a better understanding of

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1 some fine points of NRC parlance and documentation,
2 but at bottom, no, my opinions remain the same.

3 MS. CHANCELLOR: Thank you, Dr. Arabasz.
4 I have nothing further.

5 JUDGE FARRAR: Mr. Gaukler?

6 MR. GAUKLER: Nothing further,
7 Your Honor.

8 JUDGE FARRAR: Mr. Turk?

9 MR. TURK: No, Your Honor.

10 JUDGE FARRAR: All right. Then, Dr.
11 Arabasz, the good news for you is you are excused.

12 THE WITNESS: Thank you, Your Honor.

13 JUDGE FARRAR: The record will note that
14 you are smiling, and we can understand why. We
15 thank you for your testimony, which began a couple
16 of weeks ago, if I recall correctly, and you've
17 been in that chair for a long time. We appreciate
18 you sharing your views with us.

19 THE WITNESS: Thank you very much,
20 Your Honor.

21 JUDGE FARRAR: It's now a few minutes to
22 5:00. What can we get accomplished in a few
23 minutes?

24 MS. CHANCELLOR: I guess we could
25 introduce Dr. Bartlett -- are we on the record? I

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1 guess we could introduce Dr. Bartlett's testimony,
2 but I don't know that we'll get much further.

3 JUDGE FARRAR: Well, let's put it in the
4 record and -- oh, but, now, wait a minute.

5 MS. CHANCELLOR: Yeah, we'll probably
6 pick this up in Rockville, Maryland.

7 MR. GAUKLER: I have no problem going
8 ahead and putting it in. And I'll start some
9 cross-examination, but, obviously, I'm not going to
10 get done today.

11 MR. TURK: May we go off the record?

12 JUDGE FARRAR: Yes.

13 (A discussion was held off the record.)

14 JUDGE FARRAR: Let's go back on the
15 record.

16 Having consulted with the parties, we've
17 decided that it would make for an unnecessarily
18 choppy record to introduce Dr. Bartlett's testimony
19 now and not come back for some days or weeks.

20 And it is now just before 5:00, and this
21 seems like a good time to adhere to nine-to-five
22 rule, particularly since the parties have some
23 discussions that they need to conduct off the
24 record amongst themselves.

25 So we will adjourn at this time,

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1 reconvene here 9:00 here tomorrow for the
2 Bartlett/Ostadon --

3 MS. CHANCELLOR: Section D testimony.

4 JUDGE FARRAR: -- Section D testimony.

5 Thank you.

6 (The proceeding was concluded for
7 the day at 5:00 p.m.)

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CERTIFICATE

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

Name of Proceeding: Private Fuel Storage, LLC

Docket Number: Docket No. 72-22-ISFSI

ASLBP No. 97-732-02-ISFSI

Location: Salt Lake City, Utah

were held as herein appears, and that this is the
original transcript thereof for the file of the United
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15/ Diana Kent
Diana Kent
Official Reporter
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