

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

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UNITED STATES OF AMERICA
 NUCLEAR REGULATORY COMMISSION

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

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

On June 5, 2002 the above-entitled matter came
 on for hearing, pursuant to notice, before:

MICHAEL C. FARRAR, CHAIRMAN
 Administrative Judge
 U. S. Nuclear Regulatory Commission

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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- 204 Update of Deterministic Ground Motion Assessments, Revision 1 9958/
- 205 e-mail communication, Dr. Arabasz to Ivan Wong with attachments 9958/
- 206 Seismic Hazards Evaluation of the Los Alamos National Laboratory, 24 February 1995 9958/
- 207 DOE-STD-1020-2002, cover page and page C-6, including Table C-3 9958/
- 208 "Risk Reduction Ratio, Mean Return Period of Design Basis Earthquake (DBE) Ground Motions, and Target Performance Goal." 9958/
- 209 Excerpts from bullets referred to by Dr. Arabasz, bullets on the Staff's modified rulemaking Plan, SECY-01-0178 9958/

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- QQ 2002 DOE standard, first 15 pages of Appendix C 10016/10020
- RR Three pages from article by Dr. Arabasz and R.K. McGuire titled "An Introduction to Probabilistic Seismic Hazard Analysis" 10027/10027

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1 June 5, 2002

9:15 a.m.

2
3 P R O C E E D I N G S

4
5 JUDGE FARRAR: I think we're about ready
6 to get started. Are there any preliminary matters
7 we should take up?

8 MR. SOPER: There is one, your Honor.

9 JUDGE FARRAR: Okay.

10 MR. SOPER: The State has rethought its
11 objection to Exhibit 225 and the remedy proposed by
12 the Board. And in view of the fact that we don't,
13 on reflection, think that more examination is going
14 to cure Exhibit 225, the defects we're concerned
15 about, we would rather withdraw that objection and
16 have the document go in as opposed to have yet more
17 testimony concerning it. And I have consulted with
18 Mr. Gaukler on that and he has agreed that if we
19 want to do that, then apparently he has no
20 objection to withdrawing it, the State withdrawing
21 their objection.

22 JUDGE FARRAR: So it would come in as
23 is?

24 MR. GAUKLER: That's correct. That's my
25 understanding, your Honor.

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1 JUDGE FARRAR: Then, Mr. Soper, one, we
2 owe Mr. Travieso-Diaz an apology for making him
3 work all night, assuming he did.

4 MR. SOPER: I made that apology, your
5 Honor, profusely.

6 JUDGE FARRAR: But second, and obviously
7 more important, to the extent that in the report
8 are unsworn -- to the extent the report is not
9 technical but it has, in essence, the unsworn --

10 MR. GAUKLER: Testimony.

11 JUDGE FARRAR: -- opinion testimony
12 about the strength of your witness, how do we cure
13 that? Are you willing to say we'll take that just
14 as if it was sworn testimony? Or it is what it is?

15 MR. GAUKLER: Could I just add, I think
16 they've already testified to that on the stand
17 directly. And Dr. Soler testified to the report,
18 that it was prepared by him and under his
19 supervision.

20 JUDGE FARRAR: They did say, I think, at
21 one point yesterday that they would be willing to
22 swear to it.

23 MR. GAUKLER: Yes, they did.

24 MR. SOPER: I was trying to recall
25 whether they said they were willing to or they did,

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1 but maybe if we can --

2 JUDGE FARRAR: They're coming back at
3 some point?

4 MR. GAUKLER: Yes, yes. We have some
5 redirect and we'll just ask them that.

6 JUDGE FARRAR: We'll just ask them that.
7 That won't add to its substance or lack thereof,
8 but it will at least allow us to treat it as though
9 it were testimony. And, Mr. Soper, we will still,
10 though, allow you when they come back, if you want
11 to cross-examine them further on anything in that
12 Exhibit, we'll allow you to do that. In other
13 words, the Exhibit -- we will now admit the
14 Exhibit.

15 MS. CHANCELLOR: Your Honor, just one
16 moment. There are parts of that Exhibit that go to
17 Dr. Ostadan and Dr. Bartlett's testimony, and you
18 were going to hold it up on that.

19 JUDGE FARRAR: You're right.
20 Notwithstanding what we said 30 seconds ago, we
21 will not admit the Exhibit at this time, but
22 withhold it to the Ostadan testimony. And, Mr.
23 Gaukler and Mr. Turk, I believe we reserved last
24 night, in our haste to get Dr. Khan to his plane,
25 reserved your right when he comes back for any

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1 limited additional cross we may have cut you off
2 from doing last night.

3 MR. SOPER: There is one other further
4 preliminary matter, your Honor. And, that is, I
5 can't recall if we have actually moved the State's
6 195 yet. If we haven't, we do move the admission
7 of Exhibit 195. I think it was kind of a pending
8 item that the Board hadn't ruled on.

9 MR. GAUKLER: I think we still need to
10 meet to talk to discuss the proper title. We have
11 not done that yet. That's what we need to do.

12 JUDGE FARRAR: Exhibit 195 is the grant
13 of three sets of graphs?

14 MR. SOPER: Yes. Since the --

15 JUDGE FARRAR: We needed a name, we were
16 going to relabel that and make it more descriptive?

17 MR. SOPER: Well, yeah, we were.
18 However, there are several things that have come
19 into evidence since that that have no label on
20 them. I would suggest that since PFS has the exact
21 spectral response curves coming in under that name
22 that we not call this something different than
23 that. So, if anything, we would use the same
24 title, spectral response curves, and it shows what
25 the damping percentages and the frequency is on its

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1 face.

2 JUDGE FARRAR: Two comments. I think
3 the Applicant's witnesses yesterday referred to
4 this and they understood what it meant. And
5 second, I don't think the case turns on what we
6 call this, but Mr. Gaukler, I'll hear you if you
7 think there's --

8 MR. GAUKLER: I would say just add a
9 brief title, Spectral Response Curves as a Function
10 of Damping and Frequency.

11 JUDGE FARRAR: We already know that.

12 MR. GAUKLER: Okay.

13 JUDGE FARRAR: I mean, that's a decent
14 suggestion, but I think it's been described
15 adequately in the record.

16 MR. O'NEILL: We have no objection.

17 JUDGE FARRAR: Not withstanding your
18 suggestion, Mr. Gaukler, let's admit State's 195 as
19 is.

20 (STATE'S EXHIBIT-195 ADMITTED.)

21 JUDGE FARRAR: If there are no other
22 preliminary matters, Dr. Arabasz, good to see you
23 again. Hope the feeling is mutual.

24 MR. ARABASZ: Good morning, Judge.

25 MR. FARRAR: You were previously sworn

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1 so if you will consider yourself under oath.

2 MR. ARABASZ: Yes, your Honor.

3 JUDGE FARRAR: Go ahead, Mr. Turk.

4 MR. TURK: Thank you, your Honor. Let
5 me mention, I do have two preliminary matters to
6 mention before we get started with the examination.

7 JUDGE FARRAR: Okay.

8 MR. TURK: Number one, I have
9 distributed to the Board copies of the original
10 cross-examination plan that I had given to you
11 previously for Dr. Arabasz. That bears a date of
12 May 15. As you know also, yesterday I gave you the
13 revised cross-examination plan that bears the more
14 recent date of June 1st.

15 Second, during my examination of Dr.
16 Arabasz previously I requested that the State
17 provide us copies of certain pages of documents
18 authored by Dr. Arabasz which the State had
19 previously redacted and withheld from document
20 production. The State this morning handed me a
21 copy, a complete copy of the two reports which were
22 authored by Dr. Arabasz and one with Dr. James
23 Pechman, if I'm pronouncing the name correctly.

24 MS. CHANCELLOR: It's Pechman.

25 MR. TURK: Thank you. And I do have

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1 that document here. We will want to examine Dr.
2 Arabasz on that document and will be making copies
3 of it also. So I will withhold my examination on
4 that document for the moment.

5 I believe that the document, the areas
6 that were withheld are quite relevant to the issues
7 before you now that the seismic exemption has
8 become an issue in the case. As I mentioned
9 previously, the State may well have had a valid
10 reason for withholding it previously, but now that
11 seismic exemption is an issue in the case it is a
12 relevant matter and we will present that before the
13 Board.

14 MS. CHANCELLOR: If I may comment on the
15 use of the document, your Honor, --

16 JUDGE FARRAR: Before you do, let me
17 understand. What you have gotten now is a redacted
18 version, Mr. Turk?

19 MS. CHANCELLOR: No, unredacted.

20 MR. TURK: Unredacted.

21 JUDGE FARRAR: Oh, you now have the
22 unredacted.

23 MR. TURK: Yes. And I don't know that
24 PFS has a copy of this. When I originally received
25 a copy of this document it was through the document

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1 production that had been made to PFS and I had
2 gotten copies of the documents produced. I believe
3 this was used in the depositions.

4 MR. GAUKLER: We now have a copy, your
5 Honor.

6 JUDGE FARRAR: Okay. But I'm not sure I
7 understand whether you're indicating we are going
8 to have an argument later about whether --

9 MR. TURK: No.

10 JUDGE FARRAR: -- it should have been
11 redacted in the first place?

12 MR. GAUKLER: No.

13 MR. TURK: Not at all.

14 MS. CHANCELLOR: I just wanted to
15 comment, your Honor, we could have had an argument
16 about keeping this issue out because I believe that
17 it isn't relevant and it's also covered by
18 attorney-client privilege. But rather to move the
19 proceedings along, the State decided to release a
20 complete and unredacted copy of the document.

21 JUDGE FARRAR: Okay. We appreciate
22 anything that makes our life easier. So thank you.

23 Mr. Gaukler and Mr. Soper, then as a
24 further result of your withdrawing your objection,
25 then we don't have to break at 11:00 for the --

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1 MR. GAUKLER: Well, we didn't get a
2 chance with respect to some redirect on Dr. Singh
3 and Dr. Soler because we went direct to Dr. Khan.
4 So there would still be a break at 11:00 for that
5 purpose.

6 JUDGE FARRAR: So even though we're not
7 going to do with part of what we intended, we do
8 want to break at 11:00?

9 MR. GAUKLER: Yes.

10 JUDGE FARRAR: Mr. Turk, while we're
11 doing that break, will that give your people a
12 chance to look at the previously redacted portions
13 or were you suggesting you need to come back at
14 some further date?

15 MR. TURK: No. There are three
16 paragraphs that were redacted. I have looked at
17 those paragraphs now. The first one appears --
18 maybe I should just indicate what these documents
19 are.

20 JUDGE FARRAR: No, no. I mean, that's
21 all right. In terms of the future efficiency of
22 the hearing, whatever the Exhibit yesterday might
23 have demonstrated otherwise, you all remember the
24 Exhibit of the bouncing ball and one of them never
25 stopped bouncing? Let's keep in mind how we're

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1 going to deal with the witnesses and the rebuttal
2 of each other's testimony because otherwise we will
3 be that bouncing ball that seemed never to come to
4 rest. So let's try, all of us, to plan as
5 efficiently as possible to get the witnesses in and
6 out, cover all the things we can with them so that
7 we can bring this proceeding to an efficient close.
8 Go ahead, Mr. Gaukler.

9 MR. TURK: Thank you.

10
11 DR. WALTER J. ARABASZ,
12 recalled as a witness, was examined and testified
13 further as follows:
14

15 CROSS EXAMINATION

16 BY MR. TURK:

17 Q. Good morning, Dr. Arabasz.

18 A. Good morning, Mr. Turk.

19 Q. You'll have to forgive me if I appear at
20 some points to perhaps reiterate, go over some
21 ground that we covered last time, but there has
22 been this break of several weeks and I may be
23 mentioning something just in the way of bringing us
24 all up to speed again on what the context was for
25 the question that follows.

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1 A. I understand.

2 Q. In my cross-examination of you
3 previously, we had discussed the fact that you had
4 filed a Declaration in support of the State's
5 response to the PFS Motion for Summary Disposition.
6 The motion was dated December 7, 2001 and your
7 Declaration was dated December 6, 2001.

8 A. Correct.

9 Q. And I would like to distribute at this
10 time copies of the Declaration that you filed on
11 December 6, 2001 that we had discussed at that
12 time.

13 MR. TURK: Your Honor, we're
14 distributing at this time a document entitled
15 Declaration of Dr. Walter J. Arabasz dated December
16 6, 2001, and I would like to request that this
17 document be marked for identification as Staff
18 Exhibit MM.

19 (STAFF EXHIBIT-MM MARKED.)

20 MS. CHANCELLOR: Your Honor, this is
21 already in the docketing of the PFS proceeding. I
22 don't know if we need this as an Exhibit. It's a
23 legal document. It's filed in this proceeding.
24 It's attached to the State's response to PFS's
25 Motion for Summary Disposition of Utah L, Part B.

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1 JUDGE FARRAR: And that would
2 differentiate it from the depositions.

3 MS. CHANCELLOR: That are not filed.

4 JUDGE FARRAR: -- that are official,
5 but they never were given to us as part --

6 MS. CHANCELLOR: It's not part of the
7 docketed -- the deposition transcript, unless it's
8 introduced, is not part of the docket of this
9 proceeding. I believe the Staff objected to one of
10 the State's Exhibits because it was a legal
11 document.

12 MR. TURK: Your Honor, this is not a
13 legal document. This is a sworn Declaration in the
14 nature of a Affidavit. It begins with the words,
15 "I, Dr. Walter J. Arabasz, declare under penalty of
16 perjury and pursuant to 28 U.S.C. Section 1746,"
17 etc. This is a sworn statement by the witness.

18 MS. CHANCELLOR: It's more of a
19 procedural objection, your Honor. I mean, if we
20 want to get into introducing every legal document
21 that we have filed in this proceeding that may be
22 relevant to seismic, we'll have a huge record of
23 Exhibits.

24 JUDGE FARRAR: Well, although I think,
25 and I don't know the intricacies of how the

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1 Commission's secretary sends records up to the
2 Commissioners and how they send it off to a Court
3 of Appeals if it comes to that, but it strikes me
4 that it's probably better to have this as an
5 Exhibit that would be part of the hearing part of
6 the case as opposed to just the immense docket part
7 of the case. And I think we have followed that
8 rule before, that even if something is duplicative,
9 to have it all in one place is helpful. So I
10 recognize where you're coming from, but we'll
11 overrule the objection.

12 MR. TURK: I haven't offered it yet.

13 JUDGE FARRAR: You haven't offered it
14 yet, but --

15 MS. CHANCELLOR: I'll withdraw the
16 objection then.

17 JUDGE FARRAR: Okay, thank you.

18 Q. (By Mr. Turk) Dr. Arabasz, do you
19 recognize this document?

20 A. Yes, I do, Mr. Turk.

21 Q. And it does bear your signature at page
22 17?

23 A. Correct.

24 Q. At the time that you signed this
25 Declaration, you did not have before you the Staff

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1 Supplement numbered 2 to the Safety Evaluation
2 Report, did you?

3 A. From the chronology that you've
4 developed, that's correct.

5 Q. So can you tell me, then, is it correct
6 that there's no place in this Declaration that you
7 address statements which would appear for the first
8 time in SER Supplement No. 2?

9 A. Given the chronology, yes.

10 Q. And this Declaration addresses the
11 Applicant's Motion for Summary Disposition of Utah
12 L, Part B, at that time, correct?

13 A. I believe that was the designation,
14 correct.

15 Q. And that was the designation of what is
16 now Part E of Unified Contention L/QQ, correct?

17 A. Yes.

18 Q. And for instance, in paragraph numbered
19 38, which appears on page 16, you state as follows,
20 and I'll read it and if you would, tell me if I
21 read it correctly. "In this declaration I have
22 attempted to systematically address each of the
23 bases, within my scope of expertise and testimony,
24 associated with Contention Utah L, Part B." I read
25 that correctly?

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1 A. Yes.

2 Q. In fact, I don't need to do that because
3 we will offer this into evidence. And you go on to
4 say that in your opinion, "the key contested issue
5 is the validity of PFS's claim that it has met the
6 Commission's requirement to show that the 2000-year
7 design standard is sufficiently protective of
8 public safety and property as called for by the
9 Commission in CLI-01-12."

10 And that's correct, you believed that at
11 that time you had addresses all the major issues
12 relevant to the determination of whether a
13 2000-return year return period ground motion is
14 adequate for the PFS facility, correct?

15 A. Correct.

16 Q. And you also indicate at the end of that
17 paragraph that the level of conservatism is a
18 matter that is addressed by the State's engineering
19 experts. And you state, "The State's engineering
20 experts dispute PFS assertions that it has
21 demonstrated adequate conservatism in design of
22 SSCs at the PFS facility. I defer to these experts
23 for more complete discussion of their disputes,
24 which go to the heart of appropriately conservative
25 and sufficiently protective design of the PFS

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1 facility."

2 And that was your statement at the time?

3 A. Yes.

4 Q. So it is correct, then, that in this
5 Declaration you did not directly address the
6 adequacy or the conservatism of the design of the
7 PFS facility?

8 A. Of the design, that is correct.

9 Q. And also in your testimony that's before
10 us you don't address the adequacy of design, again
11 you defer to the State's engineering experts?

12 A. Correct.

13 MR. TURK: Your Honor, I would like to
14 offer Staff Exhibit MM at this time.

15 JUDGE FARRAR: Ms. Chancellor, any
16 objection other than the procedural one we
17 discussed a few moments ago?

18 MS. CHANCELLOR: No. That's the only
19 one I have, your Honor. Although, I -- no, that's
20 all.

21 MR. GAUKLER: No objection.

22 JUDGE FARRAR: Ms. Chancellor, you don't
23 have to -- if you have something on your mind, we
24 would rather you say it.

25 MS. CHANCELLOR: Maybe Mr. Turk is going

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1 to show the relevance of this Declaration. I'll
2 just hold off.

3 JUDGE FARRAR: Okay. All things being
4 equal, we would assume it's relevant in that it's
5 another statement by -- and any time you have a
6 previous statement on the same subject by a witness
7 who is testifying, I mean --

8 MS. CHANCELLOR: That's fine, your
9 Honor.

10 JUDGE FARRAR: -- I would assume it's
11 relevant. Mr. Gaukler?

12 MR. GAUKLER: No objection, your Honor.

13 JUDGE FARRAR: All right. Then Staff MM
14 will be admitted.

15 (STAFF EXHIBIT-MM ADMITTED.)

16 Q. (By Mr. Turk) In my cross-examination
17 the last time we were together you also indicated,
18 I believe, that you agree with me that your current
19 testimony was almost a verbatim recital of this
20 Declaration that we've now admitted As staff
21 Exhibit MM. Do you recall that questioning?

22 A. Yes, I do.

23 Q. And it's correct, then, that your
24 testimony that you filed for admission before the
25 hearing -- Licensing Board in this hearing greatly

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1 resembles the Declaration that we have before us in
2 MM?

3 A. Correct.

4 Q. For instance, if we look at page 17 on
5 your prefiled testimony, question 16 asks, "Do you
6 have anything further to add?" And the answer
7 states, "In my testimony I have attempted to
8 systematically address each of the subsections" --

9 A. Excuse me, Mr. Turk. I need to --

10 Q. Answer 16 on page 17.

11 A. I see. Yes, I see where you're reading
12 from.

13 Q. And that answer 16 tracks this paragraph
14 number 38 of your Declaration, correct?

15 A. Correct.

16 Q. And again, it's almost a verbatim
17 recital of that paragraph?

18 A. Yes.

19 Q. At the time you wrote this Declaration,
20 what you had before you as a Staff safety
21 evaluation was the safety evaluation -- I'm sorry,
22 the final safety evaluation issued in September
23 2000; is that correct?

24 A. That's correct.

25 Your Honor, at this time I would like to

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1 distribute another document. Mr. O'Neill is
2 helping with this and he is distributing a letter
3 from me to the Licensing Board dated October 6,
4 2000.

5 JUDGE FARRAR: Do you want this marked?

6 MR. TURK: I'll identify it and ask that
7 it be marked as Staff Exhibit NN.

8 JUDGE FARRAR: Okay. We'll have the
9 reporter do that.

10 (STAFF EXHIBIT-NN MARKED.)

11 MR. TURK: For the record let me
12 indicate, this is a letter from me to the Licensing
13 Board dated October 6, 2000, to which is attached a
14 two-page letter from Mark Delligatti, senior
15 Project Manager at NRC to Mr. John Parkyn, Chairman
16 of PFS, dated September 29, 2000, Subject: Safety
17 Evaluation Report, TAC, T-A-C, number, L22462. And
18 this is a transmittal letter to which is attached
19 the Staff Safety Evaluation Report of September
20 2000. And in particular what I have included in
21 this Exhibit, or proposed Exhibit, is those two
22 letters, plus the cover page of the Safety
23 Evaluation Report, and then Section 2.1.6.2
24 entitled Ground Vibration and Exemption Request
25 commencing at page 2-33 of the SER.

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1 Q. (By Mr. Turk) Dr. Arabasz, do you have
2 a copy of this proposed Exhibit before you?

3 A. Yes, I do.

4 Q. And, in fact, is this the Staff SER that
5 you had before you at the time you wrote your
6 Declaration in December 2001?

7 A. Yes.

8 Q. And Section 2.6.2.1 is the section that
9 addresses the seismic exemption request, correct?

10 A. Correct.

11 Q. And it is that section that you had
12 before you and that you were addressing when you
13 wrote your Declaration?

14 A. Yes. With particular focus on the
15 reasons being put forward by the staff for the
16 2000-year return value.

17 Q. And where do you see that?

18 A. Beginning on page 2-41 and continuing on
19 page 2-42.

20 Q. Now, you say that that was the area --
21 I'm sorry. Those are the bullets that start at the
22 bottom of page 2-41 and going on through most of
23 page 2-42?

24 A. That's correct.

25 Q. You say that that part of the SER was

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1 the particular focus that you had when you wrote
2 your Declaration. Was that essentially what you
3 had reviewed before you wrote your Declaration?

4 A. I reviewed the -- of this section, the
5 entire section, but as it related to the contested
6 bases formally described as B and coming forward as
7 E of Utah Contention QQ/L, these were the most
8 direct issues relating to the arguments that have
9 been put forward prior and that were addressed in
10 the depositions of October 2001 and that were
11 remaining, in my understanding, as issues for me to
12 address in my prefiled testimony.

13 Q. I'm not sure I understood that. Were
14 there other areas of this SER, section 2.1.6.2,
15 that you believe were relevant to this contention
16 or was it really just that section of bullets that
17 you thought was relevant?

18 A. As relating to my contribution to the
19 argument, it was chiefly the bullets, again, that I
20 focused on. I read with interest and evaluated the
21 entire body of information prospective that the
22 Staff put forward in this entire section.

23 Q. There is a discussion in this section of
24 the SER, Section 2.1.6.2, for instance, that begins
25 on page 2-34, which designs the geological and

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1 seismotectonic setting of the PFS site?

2 A. I see that.

3 Q. You had read that?

4 A. Yes.

5 Q. And you read the section that begins on
6 2-35, Historical Seismicity?

7 A. Yes.

8 Q. And again on that same page, the section
9 entitled Potential Seismic Sources and Their
10 Characteristics?

11 A. Yes. I say yes because in going back to
12 my copy of this document I can see where I
13 highlighted and made notes. And yes, I recalled
14 and can affirm that I did pay attention to this.

15 Q. And the same thing on page 2-36,
16 Estimate of Ground Motion Attenuation, you had
17 reviewed that before you wrote your Declaration?

18 A. In a general way, yes.

19 Q. I'm sorry if this is a little tedious,
20 but the same thing page, 2-37, Probabilistic
21 Seismic Ground Motion Hazard, you had read that
22 before you read your Declaration?

23 A. Yes.

24 Q. Section 2-38, you read the section
25 entitled Deterministic Seismic Ground Motion

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1 Hazard?

2 A. In a general way, yes.

3 Q. And the same with 2-39, Design-Basis
4 Ground Motion?

5 A. In a general way, yes.

6 Q. And incidentally, I notice at the bottom
7 of this page 2-39, when this SER was written the
8 design peak horizontal acceleration was .53 G. And
9 the same .53 G was the peak vertical acceleration
10 for the 2000-year return period ground motion?

11 A. Correct.

12 Q. That was the state of the PSHA 2000-year
13 ground motion determination at that time?

14 A. At that time, yes.

15 Q. And then you went on and you read the
16 section beginning at 2-40, Staff Review of Ground
17 Vibration and Request for Exemption?

18 A. Yes.

19 MR. TURK: Can I have just a moment,
20 your Honor?

21 JUDGE FARRAR: Yes.

22 Q. (By Mr. Turk) I would ask you to take a
23 look at one particular statement on page 2-36. In
24 the top paragraph it begins, "One aspect of the
25 staff review included the interpretations of fault

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1 geometries for newly discovered East and West
2 faults in Skull Valley based on reflection seismic
3 data and forward modeling of gravity data in
4 Geomatrix Consultants 1999a." Do you see that
5 paragraph?

6 A. I see that.

7 Q. And do you see that in that paragraph
8 the staff continued towards the end of the
9 paragraph by stating, "The staff interprets the
10 West fault as a splay of the East fault, incapable
11 of independently generating large magnitude
12 earthquakes. Therefore, Staff finds the
13 probabilistic assessment provided by Geomatrix
14 Consultants, 1991a, acceptable, and possibly
15 conservative because the Geomatrix Consultants,
16 Inc. 1999a model considers the West fault as an
17 active seismic source." Do you see that?

18 A. I see that.

19 Q. And that was before you and you had read
20 that when you formed your opinion expressed in your
21 Declaration of December 2001, correct?

22 A. Correct.

23 MR. TURK: Your Honor, at this time I
24 would like to offer Staff Exhibit NN.

25 JUDGE FARRAR: Any objection, Ms.

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1 Chancellor?

2 MS. CHANCELLOR: No objection, your
3 Honor.

4 JUDGE FARRAR: Mr. Gaukler?

5 MR. GAUKLER: No objection, your Honor.

6 JUDGE FARRAR: Then it will be admitted.

7 (STAFF EXHIBIT-NN ADMITTED.)

8 MR. TURK: Thank you, your Honor.

9 JUDGE FARRAR: Mr. Turk, refresh my
10 recollection. Have we admitted the entire SER pro
11 forma at the beginning of the case?

12 MR. TURK: No, your Honor. At the time
13 that we went to hearing in June 2000 the only SER
14 that had been issued was the preliminary SER which
15 had been issued in 1999, September of 1999. That
16 is the one SER that was admitted as Staff Exhibit
17 A. When we began aircraft hearings this year we
18 offered, and you admitted, Staff Exhibit C, which
19 was the Consolidated SER dated March of 2002.

20 JUDGE FARRAR: The entire --

21 MR. TURK: The entire SER. And that
22 SER, as we indicated when we offered it and in
23 correspondence before the Board, that incorporates
24 SER Supplement No. 2 exactly as it appeared in
25 Supplement No. 2. What we had done was we

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1 interlaced Supplements No. 1 and 2 into the
2 September 2000 SER.

3 JUDGE FARRAR: Okay. So the document in
4 front of us now, is this the same as the pages in
5 that 2002 SER or it would have been changed to some
6 degree?

7 MR. TURK: They were changed, and that
8 will be my next question.

9 JUDGE FARRAR: Then we will admit NN.

10 Q. (By Mr. Turk) Subsequent to the filing
11 of your Declaration in December 2001, the Staff
12 issued Supplement No. 2 to its Safety Evaluation
13 Report, correct?

14 A. Correct.

15 MR. TURK: Your Honor, at this time I
16 would like to distribute another document. And I
17 would ask that this document be marked for
18 identification as Staff Exhibit OO.

19 (STAFF EXHIBIT-00 MARKED.)

20 MR. TURK: For the record, let me
21 identify this document as follows. This is a
22 letter dated January 11, 2002 from myself to the
23 Licensing Board with Judge Farrar as Chairman, in
24 contrast to the previous letter. Attached to that
25 cover page is a cover sheet marked -- actually

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1 entitled Revision 2, Safety Evaluation Report
2 Concerning The Private Fuel Storage Facility,
3 December 21, 2001. And behind that cover page is
4 Section 2.1.6.2 of SER Supplement No. 2 beginning
5 at page 14 of the SER supplement.

6 JUDGE FARRAR: All right. The reporter
7 has marked that so go ahead.

8 Q. (By Mr. Turk) Dr. Arabasz, you have a
9 copy of staff Exhibit OO before you?

10 A. I do.

11 Q. And is this, in fact, the SER Supplement
12 that the Staff issued following your -- I'm sorry,
13 following your execution of your Declaration of
14 December 6?

15 A. It certainly appears to be, yes.

16 Q. Have you seen this document before?

17 A. Yes.

18 Q. And did you review Section 2.1.6.2 of
19 SER Supplement No. 2 before you filed your
20 testimony in the proceeding?

21 A. Yes, I did.

22 MR. TURK: Your Honor, I would like to
23 offer Staff Exhibit OO at this time.

24 JUDGE FARRAR: Ms. Chancellor?

25 MS. CHANCELLOR: I assume Mr. Turk is

1 going to connect all these up. No objection, your
2 Honor.

3 JUDGE FARRAR: Mr. Gaukler?

4 MR. GAUKLER: No objection, your Honor.

5 JUDGE FARRAR: All right. Then this
6 will also be admitted.

7 (STAFF EXHIBIT-OO ADMITTED.)

8 MR. TURK: And, your Honor, if for no
9 other reason, I think it is relevant and important
10 to have before us this entire chain of SER
11 discussions so if there's ever a question as to
12 what existed in what document in what time frame it
13 will be before you in a very convenient manner.
14 And before the Commission as well.

15 JUDGE FARRAR: That's what we figured
16 you were doing. Thank you.

17 Q. (By Mr. Turk) Dr. Arabasz, you
18 indicated that you had read this document before
19 you filed your testimony. Your testimony, I
20 believe, was filed in April of 2002? That's
21 correct, it's dated April 1, 2002.

22 A. Correct.

23 Q. I believe it's at the top of page 1 of
24 your testimony in the heading.

25 A. I see that, yes.

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1 Q. So is it correct, then, that you had
2 reviewed this SER Supplement, Section 2.1.6.2 in
3 Staff Exhibit OO, before you filed your testimony?

4 A. Correct.

5 Q. Was there anything in this document,
6 Staff Exhibit OO, that led you to change your
7 Declaration or statements appearing in your
8 Declaration as filed in December up to the point
9 where those statements appear -- strike that.

10 Was there anything in Staff Exhibit OO
11 that you considered expressly that you had
12 addressed explicitly in your testimony other than
13 what you had previously described in your
14 Declaration with regard to the SER of September
15 2000?

16 A. I observed that the reasons put forward
17 by the Staff in the Revision 2 of December 2001
18 were verbatim, except for one sentence, a
19 duplication of the reasons put forth in the SER
20 identified as Staff Exhibit NN, and I considered
21 the information, certainly, that had resulted from
22 updates in the ground motion analyses information
23 arguments that the Staff had put forward relating
24 to interpretations of conservatism.

25 But the context as I approached my

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1 prefiled testimony, and I explained this in answer
2 4, that there had been a moving target in terms of
3 issues to be critically evaluated by me and, all
4 things considered, as I set down to enter my
5 prefiled testimony with all of the information
6 before me, I basically was exactly at where I was
7 in, I believe the date was December, when in
8 responding to PFS's Motion for Summary Disposition
9 to recap my part of the State's arguments relating
10 to these bases prior referred to as Part B of Utah
11 L, now referred to as Section E of Utah L/QQ.

12 And in December of 2001 I had looked at
13 all of the arguments made in the past, all of the
14 information brought forward, and I gave my best
15 shot at a critical evaluation and what I thought
16 were the issues to be challenged at the time of
17 filing the prefiled testimony here dated April 1,
18 2002, I found myself in the same position.

19 Q. You mentioned that you found that the
20 SER Supplement No. 2 revision was verbatim except
21 for one sentence?

22 A. The bullets, the reasons put forward.

23 Q. And which sentence is that?

24 A. In looking at Staff Exhibit OO, and on
25 page 34, which would be the end of the second

1 bullet, there is a sentence that begins "Further,
2 analyses of nuclear power plants in the western
3 United States show that the estimated average mean
4 annual probability of exceeding the safe shutdown
5 earthquake is 2.0 times 10 to the minus 4, (U.S.
6 Department of Energy, 1997)."

7 Q. And that differs in the SER Supplement
8 No. 2? Is that what your statement was, that
9 that's the only area that was different? I'm
10 sorry, that statement of SER Supplement No. 2
11 differs from what existed in Staff Exhibit NN?

12 A. It is an added sentence. The rest of
13 the text is verbatim.

14 Q. And aside from that there is no other
15 revision in the SER Supplement No. 2 that you
16 believe would be relevant to the issues that you
17 address in this proceeding?

18 A. Correct.

19 Q. And I believe in the last session that
20 we shared, cross-examination, we had established
21 that Ms. Chancellor essentially took your
22 Declaration, and tell me if this is incorrect, but
23 my recollection was Ms. Chancellor had taken your
24 Declaration, recrafted it into your testimony, you
25 reviewed it and determined that it was accurate and

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1 that you were satisfied with it and then you
2 submitted it?

3 A. In essence, she created a draft form.
4 My memory fails me as to how the shaping of the
5 question and answer recrafting evolved. But as
6 you've described it, I think that's a fair
7 characterization.

8 Q. Well, were you asked to evaluate the
9 adequacy of the PFS PSHA in this proceeding?

10 A. I need to understand your terms. When
11 you say, "the adequacy of the PSHA," do you mean
12 the methodology and process or the result?

13 Q. I would include both. Could you explain
14 what you were asked to do?

15 A. I recounted the beginning of my
16 involvement in this process in assisting the State
17 as beginning in August 1998 and later that year
18 being given the Applicant's SAR, the geologic and
19 seismologic sections to review. I was subsequently
20 asked to review the Geomatrix 1999 PSHA and review
21 that carefully. And then I, through this process,
22 have been aware of changes in the outcome of
23 various analyses both deterministic and
24 probabilistic.

25 Q. You mentioned before that you had a part

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1 of the State argument. As I recall your testimony
2 a few minutes ago, you stated that after looking at
3 the SER Supplement No. 2 you are in the same
4 position you were at before with respect to your
5 part of the State argument. Now, my question to
6 you is -- and I hope that's an accurate
7 characterization. If it's not you're welcome to
8 correct it.

9 A. Yes, that's what we discussed.

10 Q. And I was curious, what is your part of
11 the State argument that you just referred to?

12 A. My part of the State argument I think is
13 fairly well outlined in my prefiled testimony as it
14 relates to the subsections E of Utah L/QQ, where I
15 do not enter into the argument notably with the
16 dose analyses, that's clearly identified. And
17 ultimately I declare my need to rely on the State's
18 engineering experts, and make that clear within the
19 text and at the end of the prefiled testimony.

20 But the rest of the prefiled testimony
21 basically links me to arguments put forward in the
22 various subsections of Part E.

23 Q. Your part of the State's argument, I
24 take it, would include whether the seismic hazard
25 at the PFS site had been adequately described?

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1 A. Correct.

2 Q. And would it also include whether the
3 seismic hazard assessment was conservative or not?

4 MS. CHANCELLOR: Could Mr. Turk define
5 whether he's talking about Utah L, Part B, or as
6 we're talking about now, Utah L/QQ, Section E, or
7 are we talking about Sections A -- or is he also
8 encompassing in his questions Section A and B
9 because we have stipulated to both Sections A and
10 B?

11 JUDGE FARRAR: Mr. Turk?

12 MR. TURK: What Ms. Chancellor raises is
13 whether or not I'm talking about the ground motion
14 and faulting issues that previously existed in
15 Parts A and B of former Contention L. I don't know
16 if I have the enumeration correct or not.

17 MS. CHANCELLOR: Yes. Original
18 Contention L, Basis 1 and 2.

19 MR. TURK: Also Unified Contention L/QQ,
20 A and B, were resolved by agreement of the parties.

21 MS. CHANCELLOR: That's correct. A
22 dealt with site characterization; B dealt with
23 ground motions, and a lot of that related to the
24 adequacy of the PSHA.

25 MR. TURK: And my question to Dr.

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1 Arabasz is did his part in the State's argument
2 include whether or not the seismic hazard
3 characterization was conservative or not
4 conservative. I would like Dr. Arabasz to tell me
5 whether he views that to be relevant to the
6 2000-year return period or not.

7 JUDGE FARRAR: Ms. Chancellor, your
8 concern is that this could be touching matters that
9 have been resolved by stipulation? But don't we
10 have to allow some -- I mean, I take it this is
11 kind of background for what the witness' opinion is
12 rather than rehashing something that's --

13 MS. CHANCELLOR: Mr. Turk's final
14 question is fine, your Honor. I just want to make
15 sure that he's just not limiting it to the seismic
16 exemption where Dr. Arabasz was identified as a
17 testifying witness for issues that we have
18 stipulated to.

19 JUDGE FARRAR: All right. Then on that
20 understanding, go ahead, Mr. Turk. Or does the
21 witness need the question repeated?

22 DR. ARABASZ: No. I think I understand
23 that the question in terms of my role in advising
24 the State addressing conservatism of the PSHA, and
25 I would reply that my role related to evaluating

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1 the adequacy of the PSHA. You touch on a key term,
2 "conservative." That appears in a number of places
3 in the Staff's discussion and argument, and I have
4 an opinion about that issue of conservatism.

5 Q. (By Mr. Turk) Well, my first question
6 to you was whether your part of the State argument
7 includes whether or not the seismic hazard has been
8 conservatively described in the PFS PSHA?

9 A. And I replied no, that my part in the
10 State's argument was determining whether the
11 seismic hazard had been adequately described.

12 MR. TURK: I would like to pass out
13 another document at this time, your Honor.

14 JUDGE FARRAR: All right.

15 DR. ARABASZ: Excuse me, Mr. Turk. This
16 appears to be a duplicate document.

17 MR. TURK: For the record, let me
18 identify this document. If we're passing out the
19 correct one, it should be a letter from me to the
20 Licensing Board dated January 11, 2001. It is the
21 same Exhibit as Staff Exhibit OO with the exception
22 that at the upper right-hand corner of the first
23 page you should be looking at a handwritten comment
24 that says, "With 12/01 Revisions Highlighted." Do
25 you have that copy in front of you?

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1 DR. ARABASZ: Yes, I do.

2 MR. TURK: Your Honor, I would like to
3 have this document marked for identification as
4 Staff Exhibit PP.

5 JUDGE FARRAR: All right. The reporter
6 will do that.

7 (STAFF EXHIBIT-PP MARKED.)

8 Q. (By Mr. Turk) Dr. Arabasz, is it --

9 JUDGE FARRAR: Mr. Turk, before we ask
10 the following question -- or ask the next question,
11 this may be timely for me to ask a question.

12 Looking at this document you just handed
13 out, PP, with the revisions highlighted, I seem to
14 remember in some prior life of mine, maybe on the
15 Appeal Board, we used to get documents that were
16 revisions, and when they were lengthy documents
17 there would be a little vertical line in the margin
18 so the reader could quickly see what the changes
19 were from the prior version. Is that a practice
20 the Staff used to follow with Environmental Impact
21 Statements and SERs, or am I remembering some other
22 phase of my life?

23 MR. TURK: You're remembering a present
24 and former phase. In fact, our Consolidated SER
25 does bear sideline notations where changes have

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1 been made from the previous September 2000 SER. So
2 that is our common Staff practice to make side-bar
3 notations.

4 JUDGE FARRAR: And let me ask one other
5 question. The cross-examination plan you gave us,
6 of course, is under our practice Confidential until
7 after the case is over, but it's not revealing any
8 confidences to indicate. It has 31 items on it.
9 We have been going 40 minutes on item 1. I take it
10 a number of your other items will be much shorter
11 than this?

12 MR. TURK: Yes.

13 Q. (By Mr. Turk) Dr. Arabasz, have you had
14 a chance to look at this document that's been
15 marked for identification as Staff Exhibit PP?

16 A. No. I have just recognized that this is
17 the document you intend to refer to.

18 MR. TURK: Let me state for the record
19 that what this document shows, your Honor, are
20 underlinings and frames placed around new material
21 in SER Supplement No. 2 that did not appear in the
22 SER of September 2000. And in two cases where
23 words had changed slightly I indicated in the
24 margin with the words "previously had been" with a
25 strike-out.

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1 JUDGE FARRAR: And who put these
2 markings on this document?

3 MR. TURK: I did, your Honor. And we do
4 have both documents before us. If anyone has a
5 question now or later as to whether this was an
6 accurate characterization of the documents that are
7 before us we can make that argument.

8 JUDGE LAM: So the frames indicate brand
9 new material?

10 MR. TURK: Material which have never
11 appeared in the SER of September 2000 in any form,
12 an entirely new discussion. And this is the same
13 document that Dr. Arabasz indicated he had reviewed
14 prior to filing his testimony, except without the
15 frames and the underlinings.

16 Q. (By Mr. Turk) Correct, Dr. Arabasz?

17 A. Correct.

18 Q. And you're welcome at this time if you
19 would like to do a page by page comparison in some
20 manner to assure yourself that Staff PP is, in
21 fact, the same document as OO except for the
22 underlinings and frames placed around those
23 discussions.

24 A. I'll accept your representation.

25 Q. In your testimony of April 2002 you

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1 considered this document without the underlinings
2 and frames, correct?

3 A. Correct.

4 Q. And if you look at the bottom of page
5 17, the last sentence appears to me to be the same
6 sentence that we read into the record previously.
7 If you'll note the sentence begins, "Therefore, the
8 staff found the probabilistic assessment provided
9 by Geomatrix Consultants, Inc., 1999a, to be
10 acceptable, albeit conservative." Do you see that
11 sentence?

12 A. Yes, I do.

13 Q. You note in the side I have penciled in
14 and then struck out the words "and possibly." Do
15 you see that?

16 A. Yes, I do.

17 Q. That sentence is the same sentence that
18 had appeared previously except with the changes
19 noted in this Exhibit PP, correct? Can you see
20 there that the -- I'm sorry, yes?

21 A. Excuse me, I was distracted momentarily.

22 Q. Is it correct, then, that this sentence
23 is the same sentence that we had discussed
24 previously on page 34 of Staff Exhibit OO? I'm
25 sorry, I may have just given you the wrong page.

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1 If you would turn to Exhibit NN on page 2-36, there
2 we had just read that paragraph at the top of the
3 page.

4 A. Yes.

5 Q. The last sentence of which began with
6 the same words, "Therefore, staff finds
7 probabilistic assessment provided by Geomatrix,
8 Inc. acceptable"?

9 A. Yes, I see that.

10 Q. And it's correct, then, that the
11 sentence is the same sentence in NN and both OO and
12 PP except where I've indicated in PP by
13 underlinings or by the scratch-out of a word what
14 the differences are?

15 A. Yes.

16 JUDGE FARRAR: And what page is that in
17 PP?

18 MR. TURK: Page 17, the bottom of the
19 page.

20 Q. (By Mr. Turk) So you had noticed, then,
21 that the Staff changed its position somewhat,
22 whereas, previously in this paragraph they had
23 reached the determination that the Geomatrix
24 probabilistic assessment was possibly conservative,
25 they have now made a determination that it is

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1 conservative? Do you see that difference?

2 A. They have offered an opinion that it is
3 conservative.

4 Q. Yes.

5 A. Yes.

6 Q. And they've changed their opinion from
7 being previously where they thought it was possibly
8 conservative, now they have come out very
9 affirmatively and stated it is a conservative
10 assessment, correct?

11 A. That is the opinion that they offer,
12 correct.

13 Q. Did the fact that the Staff changed its
14 opinion in this regard affect your testimony in any
15 way?

16 A. I considered this carefully because, as
17 you correctly point out, there is extensive text
18 that the staff has added and also put forward in
19 their prefiled testimony relating to their judgment
20 of conservatism variously adding adjectives such as
21 overly conservative.

22 And in the context of a PSHA, I am
23 mindful first that the Staff and its contractors
24 did not redo the entire PSHA. They examined
25 certain parameters and elements of the seismic

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1 source characterization, they performed analyses
2 such as the slip tendency analysis, which was the
3 subject of cross-examination by the State. And
4 having been involved in PSHA methodology
5 development, including involvement as an observer
6 and -- I need to refresh my memory whether I was
7 involved as a reviewer for the National Research
8 Council as it related to the Senior Seismic Hazard
9 Analysis Committee.

10 But it is very central to PSHA that what
11 a properly executed PSHA attempts to achieve is to
12 capture the technically supportable and legitimate
13 range of the informed opinion of the entire
14 scientific community on an issue. And so, by
15 analogy, if this were the Yucca Mountain PSHA an
16 analyst would have gone to the seismic source
17 characterization, honed in on a source, let's say
18 the West fault, or honed in on an analysis such as
19 the seismic slip tendency, and offered a position
20 or an opinion, that opinion then would have to be
21 challenged by the rest of the experts involved for
22 its consistency with, again, the range of
23 scientific opinion representing the whole
24 community.

25 And I understand and accept the

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1 judgments that the Staff and its consultants are
2 making with respect to conservatism. I look at
3 them with an open mind, but I am reluctant to agree
4 to the conclusion of conservatism. And if you
5 required an example we could revisit the slip
6 tendency analysis.

7 Q. Well, I thank you, but first I want to
8 focus on the question that I had asked, which was,
9 did the fact that the Staff changed its position
10 affect your testimony in any way. And I think the
11 answer is no, correct?

12 A. Correct.

13 Q. And then you started -- well, let me
14 hold off on slip tendency, I'll get to that next.
15 If you look at page 18 of staff Exhibit PP, at the
16 stop of the page it begins with a statement, "The
17 conservative nature of the applicant's source
18 characterization and PSHA results presented in the
19 SAR is evident when the results are compared to
20 PSHA results for other sites in Utah, especially
21 those in and around Salt Lake City. Such a
22 comparison shows that the seismic hazard in Skull
23 Valley was calculated by the applicant to be higher
24 than seismic hazard assessments that have been
25 performed for sites at, or near, Salt Lake City,

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1 despite the fact that fault sources near Salt Lake
2 City are larger and more active than fault sources
3 near the PFS site."

4 Then it goes on with the rest of that
5 paragraph. It also includes a discussion of the
6 comparison to the Interstate 15 reconstruction
7 project PSHA results.

8 Did the fact that the Staff made this
9 analysis represented this analysis in its SER
10 Supplement No. 2 in any way affect your testimony?

11 A. It did. And in my testimony, and I'm
12 referring to my prefiled testimony on page 13, the
13 paragraph third from the bottom that reads, "I
14 might add that the Staff's comparison between
15 probabilistic ground motions used for the design of
16 new Interstate 15 highway bridges in the Salt Lake
17 Valley and those proposed for use at the PFS site
18 is partially erroneous, and in any case irrelevant
19 due to the many differences between the two sites."

20 Q. So you considered it and reject it in
21 your testimony?

22 A. Correct.

23 Q. By the way, what part of it is partly
24 erroneous?

25 A. This was the subject of extensive

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1 discussion, the State's cross-examination relating
2 to the comparison of slip rates on the Salt Lake
3 segment of the Wasatch fault and the Stansbury
4 fault and the reference in the Staff's Exhibit PP
5 on page 18 where it says, "Ground motions estimated
6 by the applicant in Skull Valley are higher than
7 those for the I-15 corridor despite the close
8 proximity of Salt Lake City to the Wasatch fault
9 which has a slip rate nearly 10 times larger than
10 the Stansbury or East faults. Reference. Martinez
11 et al., 1998; Geomatrix Consultants 1999a."

12 Q. I recall that cross-examination. And
13 what is your view of what the difference in slip
14 rates is between the Wasatch and the Stansbury?

15 A. The slip rates on the Wasatch fault, the
16 Salt Lake City segment, on the order of 1 plus
17 millimeters per year and the slip rate on the
18 Stansbury fault .4 millimeters per year,
19 approximately.

20 Q. And where do you get the Stansbury fault
21 slip rate from?

22 A. That's from the Geomatrix Consultants
23 information. I can't recall if that was entered as
24 an Exhibit.

25 Q. You're familiar with the Martinez paper

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1 that was cited by the Staff?

2 A. Yes, I am.

3 Q. Are you familiar with that paper?

4 A. If you're going to point me to a line
5 and ask me for acute memory, no. Yes, I'm familiar
6 with the paper.

7 Q. The Martinez paper, as I recall,
8 utilized GPS positioning as a basis for its
9 calculation of slip rates, correct?

10 A. Correct, in part.

11 Q. And the Martinez paper had a slip rate
12 calculated for the Wasatch fault greater than you
13 just indicated, correct?

14 A. That's correct. And the subject of
15 considerable controversy.

16 Q. Is it correct that the Martinez paper
17 estimated the slip rate to be approximately 5
18 millimeters per year on the Wasatch fault near Salt
19 Lake City?

20 MS. CHANCELLOR: Does Dr. Arabasz need
21 to see a copy of the Martinez paper? It's a little
22 unfair to ask him to recall from memory a technical
23 paper. I'm looking for it. I think the State may
24 have entered it as part of an Exhibit.

25 MR. TURK: Dr. Stamatakos recalls that

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1 it was an Exhibit.

2 MS. CHANCELLOR: Offered as an Exhibit,
3 I don't think it was --

4 JUDGE FARRAR: Let's see if we can't put
5 it in the witness' hands rather than have him try
6 to recall it from memory.

7 MS. CHANCELLOR: I have a copy of it,
8 your Honor.

9 DR. ARABASZ: I have a copy, your
10 Honor.

11 MS. CHANCELLOR: It's State's Exhibit
12 184.

13 Q. (By Mr. Turk) Is the slip rate
14 estimated by the Martinez paper on page 569 in the
15 table at the bottom or is there another part of the
16 paper you would point us to?

17 A. Perhaps your expert Dr. Stamatakos could
18 help point me to a slip rate as associating it
19 specifically with the Wasatch fault.

20 MR. TURK: Can we take a moment, your
21 Honor?

22 JUDGE FARRAR: Yes.

23 Q. (By Mr. Turk) In fact, the Martinez
24 paper has a lot of different numbers in it. But if
25 you look at the chart that appears at the top of

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1 page 569, which is Figure 3.

2 A. Yes, I see that.

3 Q. You see there's a strong vertical line
4 indicated to be the Wasatch Fault Zone?

5 A. Yes.

6 Q. And then to the side, to the right side
7 of the area marked Wasatch Fault Zone, do you see
8 different estimates of slip rates?

9 A. I'm reading the caption to see if these
10 are, in fact, slip rates. They're not identified
11 in the caption as slip rates.

12 Q. Are these extension rates?

13 A. They're described as derived average
14 strain and velocities.

15 Q. Right. Then if you go down to the
16 bottom of the page, Table 1, the next to last
17 vertical column labeled Horizontal Displacement or
18 Fault Slip Rate in millimeters per year?

19 A. Yes.

20 Q. And you see there are different slip
21 rates stated?

22 A. I see that.

23 Q. And those are the rates that are
24 estimated by Martinez?

25 A. Correct.

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1 Q. And he does not estimate a 1 millimeter
2 slip as you describe in your testimony. The slip
3 rate that he describes is significantly larger,
4 correct? For instance, the very first one, he
5 estimates it to be 2.7, plus or minus 1.3. So
6 there's a range of 4 millimeters down to 1.4
7 millimeters?

8 A. The author is a she, Linda Martinez,
9 and --

10 Q. First could you tell me if I'm reading
11 that correctly?

12 A. Yes.

13 Q. Thank you. Go on.

14 MS. CHANCELLOR: Can the witness
15 complete his answer?

16 MR. TURK: I would be happy to. I just
17 wanted an answer to the question I had asked before
18 he explains.

19 DR. ARABASZ: I'll pause for a moment
20 and sigh because -- and I'll simply offer an
21 explanation of why I'm not enamored of this paper
22 or would take its results to influence my judgment
23 on its relevant comparison between the Wasatch and
24 the Skull Valley situation.

25 As chair of the Seismic Safety

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1 Commission, one of the authors of this paper came
2 to the Commission, presented the results, and
3 basically was advocating attention to the
4 considerably enhanced seismic hazard on the Wasatch
5 fault compared to what was conventionally believed
6 from the geological information.

7 An extensive review of the data was
8 undertaken by the Commission and with the result
9 that it was believed that the GPS data were
10 preliminary, the implications uncertain,
11 particularly as relating to an interpretation of
12 the implications of the deformation rates
13 aggregated from surface GPS measuring points and
14 what implication they had for slip rates on
15 individual faults, whether the Wasatch fault or
16 unknown faults, within the domain for which the
17 surface deformation was being monitored.

18 Q. (By Mr. Turk) You indicated that the
19 results seemed to be uncertain or preliminary. Has
20 there been more work done by the Martinez, Merkins
21 and Smith authors with respect to the subject of
22 this paper?

23 A. Reports -- or results have been
24 reported, to the best of my awareness, in meeting
25 abstracts and oral presentations and/or posters. I

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1 will admit that I am not an expert in GPS. I am
2 aware of an ongoing debate within the scientific
3 community about the interpretations and
4 implications of observed GPS deformation rates as
5 they relate to geologically observed slip rates.

6 Q. The authors have not retracted this
7 paper or submitted any correction to it or
8 modification to it, have they?

9 A. To my awareness, no.

10 Q. So to your awareness the authors have
11 not stepped back from their estimate of the slip
12 rate for the Wasatch fault since they published
13 this paper in 1998, correct?

14 A. What I'm taking time to review --

15 Q. That's fine.

16 A. -- as to whether they, indeed, reached
17 the conclusion of associating this deformation
18 entirely with the Wasatch fault. And I think in a
19 general way their inclination is to associate it
20 with the Wasatch fault, and I believe that's
21 subject to debate.

22 Q. Okay.

23 MS. CHANCELLOR: Your Honor --

24 Q. (By Mr. Turk) But my question was, to
25 your knowledge, the authors have not stepped back

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1 from their estimate of this slip rate for the
2 Wasatch fault since they published their paper in
3 1998?

4 A. To my awareness, no. I am aware that
5 the results have been contested in a scientific
6 forum, including, if I recall, an SSA abstract
7 submitted by Dr. Pechman, which was -- and the
8 controversy at the time reported in GeoTimes.

9 MS. CHANCELLOR: Your Honor, if I may,
10 State's Exhibit 184 has been offered, offered or
11 not, but it has not been admitted into evidence.
12 It was offered at transcript page 8092. I would
13 request at this time it be entered into the record.

14 JUDGE FARRAR: Do you have a copy there
15 you can just hand us for a moment?

16 MR. TURK: May we go off the record for
17 a moment?

18 JUDGE FARRAR: Yes.

19 (Discussion held off the record.)

20 JUDGE FARRAR: Let's go back on. Back
21 on the record. We're talking about State Exhibit
22 184 which was offered -- no, which was identified.

23 MS. CHANCELLOR: Identified, and I
24 believe offered -- certainly identified on May 11th
25 and marked as State's Exhibit 184.

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1 JUDGE FARRAR: At transcript 8092.

2 MS. CHANCELLOR: Correct.

3 JUDGE FARRAR: Before we ask for
4 objections, Dr. Arabasz, maybe you can help me on
5 this. And I have not read this paper so I'm not
6 familiar with it. But since when is GPS accurate
7 enough to measure millimeters? I think that's
8 somehow inconsistent with my layman's understanding
9 of their accuracy.

10 DR. ARABASZ: With continuous monitoring
11 over an extended period of time, the mean value can
12 reduce to that kind of precision.

13 JUDGE FARRAR: So an individual reading
14 would not be particularly valuable, but the average
15 over time would be?

16 DR. ARABASZ: Correct. And the problem
17 that I would have here is that if one has
18 measurements, accepting at face value their
19 accuracy, at point A, absent measurements at point
20 B, can one then go to the geological record and say
21 this asserted measurement at point A compared to
22 the geologic information at point B, can that
23 legitimately be compared.

24 JUDGE FARRAR: Refresh me. Before GPS,
25 how did you measure motion across a fault? I seem

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1 to remember that you sat up a peg on both sides and
2 you stretch a wire between them, but how did you
3 measure the movement?

4 DR. ARABASZ: For a PSHA, important
5 reliance on geology, measuring offset units, and
6 given the age of the offset unit, the displacement
7 divided by the time would give the inferat slip
8 rate on the fault, assuming it to be non-time
9 varying.

10 JUDGE FARRAR: So you didn't need to
11 know the exact position on the earth of marks on
12 both sides of the fault, you just had to keep
13 measuring the displacement between them?

14 DR. ARABASZ: Basically, yes. So you
15 have this geological information independent of
16 geodetic displacement rates.

17 JUDGE FARRAR: Right. Thank you for
18 that help. Any objection to the admission of this
19 document?

20 MR. TURK: None for the Staff, your
21 Honor.

22 MR. GAUKLER: No objection, your Honor.

23 JUDGE FARRAR: All right. Then State
24 184 would be admitted.

25 (STATE EXHIBIT-184 ADMITTED.)

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1 MR. TURK: Your Honor, I have just one
2 very brief question on this same issue that we've
3 been discussing and then I think it's a good time
4 for the morning recess, if that's all right with
5 the witness and everyone else.

6 JUDGE FARRAR: Yes.

7 Q. (By Mr. Turk) Dr. Arabasz, you
8 indicated that you don't agree with the slip rate
9 postulated in this Martinez paper and you believe
10 it would be smaller. I believe you indicated your
11 view that the difference would be approximately, is
12 it 2.5 or 3 times -- the Wasatch fault rate is 2.5
13 times or 3 times greater than the Stansbury fault
14 slip rate?

15 A. Comparing -- let's see, I would have to
16 refresh my memory on exactly what, for example, is
17 in the Geomatrix analysis for the slip rate on the
18 Salt Lake segment of the Wasatch fault. I would
19 estimate between 1 and 2 millimeters per year
20 compared to the .4 being the best value slip rate
21 on the Stansbury fault.

22 Q. Well, when you say you're not sure,
23 which Geomatrix report are you thinking of now when
24 you say there is a slip rate projected of 1 to 2
25 millimeters?

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1 A. This would presumably be the 1999 PSHA
2 document.

3 Q. The April 19 --

4 A. This was entered, as I recall, for the
5 -- as part of the -- or at least it was put before
6 the staff as part of the cross-examination when we
7 compared the slip rates on the Wasatch fault
8 compared to the Stansbury fault and the maximum
9 magnitude on the Salt Lake segment of the Wasatch
10 fault compared to the maximum magnitude on the --

11 MS. CHANCELLOR: It's Utah Exhibit 185.

12 MR. GAUKLER: 185, yes, you're right.

13 MS. CHANCELLOR: Does Dr. Arabasz need a
14 copy?

15 DR. ARABASZ: It would help, please.

16 Q. (By Mr. Turk) Are you able to look at
17 this State Exhibit 185 to find the Geomatrix
18 number?

19 A. Yes. It's the fourth page of the
20 Exhibit as part of Table 6-2 reproduced, the first
21 entry in the leftmost column for the Stansbury
22 fault. The seventh column, Slip Rate Millimeters
23 Per Year with the greatest weight .6 given to .4
24 millimeters per year.

25 Q. The greatest weight is .4?

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1 A. In square brackets, 0.6.

2 Q. I'm sorry, I lost where you're looking.

3 A. On the fourth page of the Exhibit, which
4 presents part of Table 6-2.

5 Q. And this is at the top of the page is
6 labeled page 2 of 5, correct?

7 A. I don't --

8 Q. On the right side?

9 A. Yes, that is correct.

10 Q. And that's 0.4 millimeter slip rate and
11 the weighting given to that is 0.6, or at least
12 that's the best estimate?

13 A. Correct. And for comparison, page 5 of
14 5 for the Wasatch fault, continuing from the
15 previous page, the entry unsegmented model, the
16 greatest weight given to -- the greatest weight is
17 0.4 given to a slip rate of 1.1 millimeters per
18 year, and an entry is not given for the segmented
19 model for the Salt Lake segment.

20 Q. If we accept the Geomatrix numbers, we
21 would be comparing a 1.1 for the Wasatch to a 0.4
22 for the Stansbury, correct?

23 A. Correct.

24 Q. Slip rate. So that under the Geomatrix
25 numbers the Wasatch fault slip rate unsegmented

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1 model is approximately three times greater than the
2 slip rate for the Stansbury fault?

3 A. Correct.

4 Q. And is it correct that the slip rate is
5 an important component in determining the seismic
6 hazard of a site?

7 A. Yes.

8 Q. Even if the Staff is wrong at page 18 of
9 Staff Exhibit PP, the SER Supplement No. 2, and the
10 slip rate is only three times or four times, as you
11 mentioned you could say approximately four times
12 greater at Wasatch than Stansbury, rather than 10
13 times as the Staff states, that still would
14 indicate conservatism in the Geomatrix PSHA for the
15 PFS site, wouldn't it, but instead of being a 10
16 times greater number it would be a 4 times greater
17 number?

18 A. If I understand your question, and I'm
19 trying to track it carefully, the conservatism in
20 the PSHA, my simple answer would be guarded, and it
21 would be no because simply in a PSHA the mickle
22 makes a muckle. You have an incredible spectrum of
23 parameters and values to be aggregated in a process
24 of calculating the hazard. There are differences
25 in site response, certainly. The distance to the

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1 Wasatch fault is not specified in a comparison
2 site, and one would have to look at a parameter
3 selection, change the parameter, if one will, grind
4 it all out and see what comes out.

5 Q. If we only looked at this one element,
6 you would agree that the fact that the Wasatch
7 fault had a slip rate, according to Geomatrix,
8 that's 4 times larger than the Stansbury fault slip
9 rate, that would be an important consideration in
10 determining the conservatism or nonconservatism of
11 the PFS PSHA?

12 MS. CHANCELLOR: Objection, your Honor,
13 asked and answered.

14 JUDGE FARRAR: Mr. Turk, have we covered
15 it?

16 MR. TURK: That's my last question and
17 it has not been asked or answered.

18 JUDGE FARRAR: Okay. I think we're
19 coming close to exhausting this, but go ahead,
20 we'll permit the question.

21 MR. TURK: Do you need the question
22 reread? Why don't you reread the question just for
23 precision.

24 (Pending question read back as follows:)

25 "Q If we only looked at this one

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1 element, you would agree that the fact
2 that the Wasatch fault had a slip rate,
3 according to Geomatrix, that's 4 times
4 larger than the Stansbury fault slip
5 rate, that would be an important
6 consideration in determining the
7 conservatism or nonconservatism of the
8 PFS PSHA?"

9 DR. ARABASZ: Mr. Turk, with due
10 respect, it's an ill-posed question. And what --
11 we need to understand what we are comparing in the
12 PSHA. If we had two sources, or let's say if we
13 had one source which was a contributor to the PSHA
14 outcome at Skull Valley, and we increased the slip
15 rate on this seismic source of fault from .4
16 millimeters per year to 1.1 millimeters per year,
17 yes, the hazard would increase. But I'll come back
18 to my respectful reply that the question is
19 ill-posed and very difficult for me to answer.

20 MR. TURK: I thank you. Your Honor, I
21 think it's a good time for a break. I'm sorry, but
22 I'm going to need to come back to this document,
23 but let's do it after a break. When I say "this
24 document," I'm looking at Staff PP.

25 MS. CHANCELLOR: Your Honor, can we get

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1 an idea of how much longer Mr. Turk has with Dr.
2 Arabasz?

3 MR. TURK: Do you want to go until
4 11:30? Are we going to start the next panel?

5 JUDGE FARRAR: No. Well, we need a
6 break. But how long will you need with Dr.
7 Arabasz?

8 MR. TURK: By my reckoning, I have gone
9 for about an hour and-a-half, or less because we
10 started little late after all the preliminaries. I
11 would estimate another roughly three hours.

12 MS. CHANCELLOR: Three more hours?

13 MR. TURK: Yes.

14 MS. CHANCELLOR: Thank you.

15 JUDGE FARRAR: Let's come back at five
16 after. It's 13 of, let's come back at 5 after.
17 And we'll switch to the other panel.

18 MR. TURK: Your Honor, if I have not
19 done it, and I don't believe I have, I would like
20 to offer Staff Exhibit PP at this time.

21 JUDGE FARRAR: Any objection?

22 MR. GAUKLER: No objection.

23 MS. CHANCELLOR: No objection.

24 JUDGE FARRAR: Okay. That will be
25 admitted.

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1 (STAFF EXHIBIT-PP ADMITTED.)

2 (Recess taken.)

3

4 KRISHNA SINGH AND ALAN SOLER,

5 recalled as witnesses, were examined and testified

6 further as follows:

7

8 JUDGE FARRAR: All right. We're back on

9 with a different panel, Dr. Singh, Dr. Soler,

10 you've previously been sworn. So again, you're

11 still under oath.

12 Mr. Travieso-Diaz, I guess you were the

13 only one not in on the joke yesterday that we were

14 not going to make use of the work that you probably

15 spent all night long doing. We appreciate your

16 effort and it was worthwhile endeavor.

17 MR. TRAVIESO-DIAZ: Mr. Chairman, I

18 wasn't aware of the joke. I was told. Just a few

19 minutes ago, unfortunately.

20 I would like to represent to the Board

21 for the record that the witnesses are able and

22 prepared to tie each of the statements of a

23 nontechnical nature in Exhibit 225 to a specific

24 portion of the record if that makes a more complete

25 record. It's entirely up to the Board. I don't

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1 know whether you want to hear that or not. The
2 information is available.

3 JUDGE FARRAR: How long would it take
4 you to do that?

5 MR. TRAVIESO-DIAZ: My best guess is
6 about 15 minutes.

7 (The Board confers off the record.)

8 JUDGE FARRAR: We think, having
9 consulted with my colleagues, we think it might
10 help the further understanding of the record if we
11 did that. What we would ask counsel and the
12 witnesses is, we're not looking for an elaboration
13 of the reasons, but just what were they addressing
14 here, you know, kind of a quick version of it.

15 MR. TRAVIESO-DIAZ: Our intention was to
16 provide specific references so that it can be tied,
17 the record can be tied to the Exhibit and vice
18 versa, if that's agreeable.

19 JUDGE FARRAR: Okay. Let us make sure
20 that we -- so we're dealing with Exhibit 225?

21 MR. TRAVIESO-DIAZ: That is correct.

22 JUDGE FARRAR: Then go ahead.

23 MR. SOPER: Might I be heard first, your
24 Honor?

25 JUDGE FARRAR: Yes.

1 MR. SOPER: One of the purposes in the
2 State's withdrawing its objection is not to go
3 through a third bite on this subject. We've had
4 rebuttal testimony, we've had the Exhibit, which we
5 objected to because it's also testimony. And on
6 reflection, to yet do more rebuttal testimony,
7 because I suspect it will not be merely pointing
8 things out, but will have opinions and arguments
9 laced in with it, and on reflection withdrawing the
10 objection was not to go through this.

11 MR. TRAVIESO-DIAZ: I'm prepared to
12 represent to the Board and Mr. Soper that all we're
13 going to go to the references, and I think that may
14 make the record clear. But, again, it's of no
15 consequence to me whether we do it or not.

16 MR. SOPER: Here's, why, your Honor.
17 The document was prepared to go in without
18 supporting testimony and offered on that basis.
19 Now, if we're going to have more testimony to clear
20 it up, then I would like to renew my objection
21 because it was sort of conditioned on not doing
22 this.

23 JUDGE FARRAR: Okay.

24 (The Board confers off the record.)

25 JUDGE FARRAR: Given the nature of the

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1 State's original objection and the conditions of
2 their withdrawal of the objection, then we will
3 honor their request, Mr. Travieso-Diaz, not to have
4 you do the drill we just talked about. And any
5 references you want to supply in your post hearing
6 filings in your brief or argumentation would, of
7 course, be useful to everyone. But we would leave
8 it for then rather than, as Mr. Soper
9 characterizes, take the third bite at the apple.
10 So we appreciate your offer, but given the State's
11 position we would decline to accept it.

12 MR. TRAVIESO-DIAZ: We will be happy to
13 do that.

14
15 REDIRECT EXAMINATION

16 BY MR. TRAVIESO-DIAZ:

17 Q. Dr. Singh, yesterday you were asked a
18 number of questions by Mr. Soper on the State
19 Exhibit 197. Do you have a copy of that document
20 with you?

21 DR. SINGH: I believe I do. Let me find
22 it. Okay. Yes, I do.

23 Q. I believe the parties have copies. I am
24 going to make it available to the Board in case it
25 makes it easier for you to follow.

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1 JUDGE FARRAR: Thank you.

2 Q. (By Mr. Travieso-Diaz) For the record,
3 State Exhibit 197 is a series of documents relating
4 to the possible performance of shake table tests.
5 If I recall your examination, Dr. Singh, yesterday,
6 you testified that Holtec proposed to PFS and to
7 other clients that they join to finance a shake
8 table test program; is that right?

9 DR. SINGH: That's correct.

10 Q. Why did Holtec do this?

11 DR. SINGH: We did this to satisfy NRC's
12 implicit request through meetings to get our
13 HI-STORM system licensed in a generic manner for
14 all sites everywhere.

15 Q. What was the Holtec doing vis-a-vis the
16 NRC at that time?

17 DR. SINGH: At that point we were
18 engaged in attempting to get certification for the
19 HI-STAR system, for -- under general CoC
20 provisions.

21 Q. And was your position at the time to try
22 to get a blowing off certification that would cover
23 all possible sites?

24 DR. SINGH: Yes, sir.

25 Q. Did you ever get such a certification?

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1 DR. SINGH: We received a certification
2 that it would not cover all the sites.

3 Q. What limitations did it have?

4 DR. SINGH: There are limitations under
5 the general CoC on the extent of ZPA (zero period
6 acceleration) under general certification.

7 Q. Are you saying that not all sites will
8 be able to take advantage of the CoC?

9 DR. SINGH: That is correct.

10 Q. And would the sites that would not be
11 able to take advantage of the CoC would be those
12 sites in which the expected seismic ground motions
13 would be in excess of a given figure?

14 DR. SINGH: That is correct.

15 Q. Whose idea was it that this shake tables
16 be considered?

17 DR. SINGH: The idea originated in
18 discussions with the NRC from the NRC.

19 Q. And were these tests intended to be
20 tailored to any particular plant?

21 DR. SINGH: No.

22 Q. How far along did this concept of
23 considering the shake table tests go?

24 DR. SINGH: It didn't go very far at
25 all. Actually, as I said yesterday when Mr. Soper

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1 brought it up, I didn't know where he was coming
2 from and I had no recollection at the time.

3 Q. Did you ever get during that period of
4 time to the point of determining whether the
5 performance of such shake table tests was feasible?

6 DR. SINGH: Yes. We -- at the time we
7 did do some, I would say, cursory evaluations.

8 Q. And what was the result of this cursory
9 evaluations?

10 DR. SINGH: The result was that the
11 shake table testing will not illuminate the matter
12 of cask dynamics.

13 Q. What was the basis for that conclusion?

14 DR. SINGH: The basis -- there were two
15 bases. One, of course, was ongoing interaction
16 with the NRC where we attempted to explain to them
17 that our dynamic analysis methodology is robust,
18 dependable and the response of the cask can be
19 predicted with great confidence.

20 The other part was some experiments that
21 had been done in Japan with great expense over a
22 long time, I guess it took several years, and in
23 the end the experiments turned out to give
24 virtually useless information with respect to the
25 response of casks in actual earthquakes.

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1 Q. To what extent did you become familiar
2 with the Japanese test program?

3 DR. SINGH: I became familiar with the
4 Japanese test program to the extent that I met with
5 -- I spoke to -- there was a delegation in our
6 offices from Japan to discuss business at large,
7 and one member happened to be -- have participated
8 in this program and I had brief discussions with
9 him. And he basically related to me and to some of
10 the people in our -- in that meeting from Holtec
11 that the program took a long time and the data he
12 had, he briefly summarized it. We asked questions
13 on the validity of the data and it became apparent
14 in the discussion that the program had not gone
15 much further.

16 I had also gone to Japan. I go to Japan
17 every couple of years on business. At one time I
18 had taken a tour of CREIPI facilities. That's
19 Japanese, if you will, and they were running a
20 number of programs; testing casks, carbon dating
21 programs, radiation programs, all sorts of
22 programs. I took a tour and I saw the place where
23 they had the shake table, and the apparatus and
24 equipment were dismantled at that time and the
25 program had been at that time been abandoned.

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1 Again, we had repeated in this matter
2 and it became -- over time I guess subliminally the
3 idea consolidated in my own thought process that to
4 test a friction supported large structure on a
5 shake table may have been the only alternative 15
6 years ago, but at the present time it has no
7 meaningful -- it will serve no meaningful purpose.

8 Q. I think you said that in your
9 conversations with a Japanese representatives, both
10 in the U.S. and Japan, you came to learn of
11 difficulties they were having or they had
12 experienced in running these tests?

13 DR. SINGH: I wouldn't characterize it
14 that way. I got the distinct sense from talking to
15 them -- I didn't discuss the details of the
16 problems with them, more to the results they
17 received and the difficulty in correlating those
18 results to a meaningful seismic response.

19 Q. Let me rephrase the question. What did
20 you learn from talking to the Japanese about the
21 results of the tests and whatever shortcomings
22 those results may have had?

23 DR. SINGH: The shortcoming of the
24 results was that they could not be readily
25 correlated with a numerical program and, therefore,

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1 it could not be used as a reliable benchmark.

2 Q. Maybe you need to explain what you mean,
3 couldn't be correlated.

4 DR. SINGH: Correlating a program means
5 that you are able to measure all critical variables
6 that participate in the dynamic behavior of the
7 equipment and then set your parameters accordingly
8 in your computer program and see how well the
9 program -- the results predicted by the program
10 correlate with the test data. That correlation is
11 the critical and most vital part of an experimental
12 program, and that could not be done with any
13 accuracy.

14 Q. From the dates in the documents that are
15 part of State Exhibit 197 I get the understanding
16 that there are changes in this matter took place in
17 '97 and early '98; is that correct?

18 DR. SINGH: Looking at the documents it
19 seems that way, yes.

20 Q. Has the NRC since that time conducted
21 original analysis and tests to better understand
22 the performance of spent fuel facilities in the
23 presence of seismic events?

24 DR. SINGH: I don't wish to speak for
25 the NRC, but to my knowledge I can tell you that

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1 NRC has come light years in terms of modeling and
2 understanding behavior of casks, as have we. They
3 have sponsored, NRC in these proceedings, work by
4 the Sandia National Laboratories. I know they have
5 sponsored impact and related nonlinear dynamic work
6 with the Lawrence Livermore Laboratories.

7 I'm also aware that on their own staff
8 they have added personnel with analysis
9 capabilities in these areas, and I think that the
10 NRC understanding as a scientific institution, I
11 don't mean as a regulatory institution, is at par
12 with any other institution in the country. I
13 believe in the past two or three years I have not
14 heard any talk of running experiments from the NRC.

15 Q. Has the NRC suggested or recommended to
16 you since 1997-98 that it might be a good idea to
17 consider shake table tests?

18 DR. SINGH: Not to me, they have not.

19 Q. Are you aware of whether the NRC has
20 made such a suggestion or recommendation to anybody
21 else?

22 DR. SINGH: I'm not aware of that.

23 Q. You said in response to a question that
24 Chairman Farrar asked you yesterday that you had
25 the technical equipment to moral certainty that the

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1 PFS storage casks would not have tip over in an
2 earthquake. How can you be so sure if you have no
3 test results to confirm or to validate that
4 conclusion?

5 DR. SINGH: You're asking Mr. Soper's
6 question for me.

7 Q. I think it's a good question.

8 DR. SINGH: It's a good question. I
9 think it may be difficult for me to communicate the
10 sense of certainty and give you a feel in this
11 matter, but I will do my best.

12 The prediction of the behavior of the
13 cask under seismic loadings is laced in this
14 computer models that we have, is laced with
15 conservatisms. We are not predicting how many
16 degrees the cask will rotate during the earthquake,
17 we are predicting here the maximum potential
18 rotation. If all uncertainties were to, in the
19 most devious combination, were to work against the
20 system in a particular earthquake. I have stated
21 before the rattling of the fuel which can dissipate
22 energy, rattling of the basket, rattling of the
23 canister, all of the impact dampings are completely
24 ignored in this model. There are layers upon
25 layers of conservatisms in the VisualNastran runs

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1 that we have shown, in the DYNAMO runs we have
2 shown.

3 Now, this is how the evaluation has been
4 done. And it's been done using principles which
5 allowed NASA to put a man on the moon for the first
6 time without running any shake table experiments.
7 The entire calculation of how a rocket, a satellite
8 goes in space and goes to the moon is based on
9 Newton's laws of motion. They are unimpeachable,
10 they've never been questioned. That is what
11 allowed in the first attempt in 1969 to put a man
12 on the moon. It's all solving Newton's equation of
13 motion. That's what we do here.

14 If I don't believe in them then I have
15 no moral basis to believe in any scientific fact.
16 Realize that the basis are twofold. One is that
17 the model is conservative. We are not looking for
18 precision that NASA was to put a man on the moon
19 precisely at a spot. We were looking to be sure --
20 our mission is far less formidable. We were simply
21 trying to make sure that the structure, the models
22 are sufficiently conservative to give us a
23 conservative portrayal of the response of the
24 system. It's much more of a modest mission than to
25 precisely predict response. And that's why I feel

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1 absolute technical certainty that these casks will
2 not tip over even under the 10,000 year and beyond
3 design basis at the Skull Valley site.

4 Q. Are you suggesting by your answer that
5 there is no place in the design and licensing or
6 fine idea for performance shake table tests?

7 DR. SINGH: That's correct. I believe
8 that shake tables have had a place under the sun
9 for small equipment with tight tolerances where
10 tolerances make a big difference in the behavior of
11 the equipment, such as small electrical equipment,
12 shake tables do have a role to play even today.
13 But understand, that over time the role of shake
14 tables in nuclear safety work has been steadily
15 diminishing.

16 If you went 15 years ago and looked at a
17 facilities in the United States, shake tables were
18 busy all over. If you go today, most of them have
19 covers on them and dust is accumulating. The
20 reason is that the ability to predict response of
21 structures has improved dramatically over the
22 years. Today, in 2001 and 2002, we can dissect the
23 response of the cask to the level of detail one
24 chooses. It could not be done in 1985. The
25 enhances in dynamic behavior of large systems today

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1 is far more effective than the shake table could
2 be.

3 A shake table fundamentally is limited.
4 It cannot be used, as I said yesterday, in large
5 structures, friction supported, where friction by
6 definition again is an elusive quantity, as you
7 know, and where we have significant amounts of
8 impact damping present in this structure. A shake
9 table is simply not the right way, a meaningful way
10 to characterize such a structure.

11 MR. TRAVIESO-DIAZ: Thank you, Dr.
12 Singh. Let's move to Mr. Soler.

13 JUDGE LAM: If I may interrupt.

14 MR. TRAVIESO-DIAZ: Absolutely.

15 JUDGE LAM: Dr. Singh, would your
16 absolute confidence that the cask would not tip
17 over even in the 10,000 years earthquake, may I ask
18 you, do you know what is the rationale for the
19 Applicant to ask for an exception here?

20 DR. SINGH: Ask for the exemption?

21 JUDGE LAM: There's no need for the
22 exemption.

23 DR. SINGH: Exemption in the regulatory
24 and legal matter, I cannot speak to it. All I can
25 say is that the earthquakes that have been devised

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1 to predict 10,000 year return earthquakes and
2 applied to a free-standing HI-STORM system with
3 absolute objectivity and technical rigor will
4 predict that there is a large margin against tip
5 over. It doesn't even come close to tipping over,
6 as you have seen. And that is what my technical
7 certainty and statements to the Board and to the
8 State and PFS and NRC are based on. I don't know
9 the legal and regulatory implications of exemptions
10 and how that works in the site specific licensing
11 space, I simply don't know.

12 JUDGE LAM: Then I would like to reserve
13 this question to the Applicant's counsel and to
14 Staff counsel. Based on what I have heard today
15 from Dr. Singh, what is the rationale for the
16 Applicant to ask for an exemption?

17 MR. TRAVIESO-DIAZ: You don't desire an
18 answer right now, do you?

19 JUDGE LAM: Oh, no. I mean, I would
20 like an answer. Sooner or later this question will
21 need to be reasked by me.

22 MR. TRAVIESO-DIAZ: I suspect that,
23 Judge Lam, that in our filings, special filings on
24 Section E will be covering that subject.

25 MR. TURK: Your Honor, you may have

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1 noticed that four lawyers reached for their
2 microphones when you asked that question. I saw
3 all three PFS lawyers move to the mikes and Mr.
4 O'Neill and I both moved to the mikes.

5 MR. TRAVIESO-DIAZ: I want the record to
6 reflect that I'm moving away from mine.

7 MR. TURK: I have less trepidation and I
8 would be happy to give you my perspective.

9 JUDGE FARRAR: Go ahead.

10 MR. TURK: The issue was design. If PFS
11 was to incorporate a deterministic design value or
12 10,000-year design value, they would have to design
13 the facility to a greater standard than they're
14 currently designing it to. The consequence may be
15 the same. The cask, our testimony presented, and
16 PFS's testimony presented, these two parties are
17 satisfied that the cask will not tip over. But the
18 facility would have to be designed to a higher
19 standard if they were to say, okay, let's forget
20 the exemption and go with a higher design standard.

21 MR. GAUKLER: If I can make an addition
22 as well, Judge Lam, I think it ties back to the
23 testimony of Dr. Cornell where we talked about the
24 conservatisms that exist and the code standards
25 that you apply as your design basis. In order

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1 words, you have your codes and standards, you apply
2 them as a design basis, and you know by virtue of
3 the conservatism in there that your system, in
4 fact, can take a much greater earthquake and you
5 have this risk reduction factor. So we talked
6 about that we can take it beyond the design basis
7 earthquake up to 10,000 years is different than
8 saying you've got to design to a design basis
9 earthquake of 10,000 years, if you understand what
10 I'm trying to say.

11 MR. TRAVIESO-DIAZ: Well, since these
12 two lawyers have already spoken, I might as well
13 join them. It goes out to simple math. If you are
14 required to design to 10,000 years, Dr. Cornell and
15 others have given you testimony that indicate that
16 you can take a 10,000-year earthquake. You aren't
17 required to design to a 10,000-year earthquake, you
18 could probably take a 20,000-year earthquake.

19 In our view, and I think the NRC shares
20 our view, that allegation of the degree of
21 conservatism to that specific is not warranted. So
22 that's why we don't believe that you need to be
23 required to design for 10,000 years because in
24 reality you will be providing a design that can
25 take 20 or more. That's my understanding, but

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1 maybe a common understanding of what's involved
2 here.

3 JUDGE LAM: Thank you, gentlemen, for
4 your answer.

5 JUDGE FARRAR: Mr. Soper, given this
6 colloquy, do you want to say anything at this
7 point? You'll have ample opportunity later, of
8 course.

9 MR. SOPER: No, I don't at this point,
10 your Honor. Thank you, though.

11 (The Board confers off the record.)

12 JUDGE FARRAR: Go ahead, counsel.

13 MR. TRAVIESO-DIAZ: Thank you.

14 Q. (By Mr. Travieso-Diaz) Dr. Singh, you
15 were yesterday asked also questions about what was
16 admitted as State Exhibit 198. Do you have a copy
17 of the document in front of you?

18 DR. SINGH: Yes, I do.

19 MR. TRAVIESO-DIAZ: Again, we're
20 distributing for convenience of the Board copies of
21 this document. This document is already in the
22 record so we don't need to mark it.

23 Q. (By Mr. Travieso-Diaz) Exhibit 198,
24 again for the record, is a letter from the NRC to
25 you, Dr. Singh, dated November 30, 1998. And in

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1 that letter the NRC asks a number of questions to
2 Holtec. First of all, this letter refers to a
3 Request for Additional Information. Will you
4 indicate for the record what a request for
5 additional information is.

6 DR. SINGH: The Request for Additional
7 Information, RAI, abbreviated, is NRC's means to
8 ask the Applicant to provide additional information
9 to supplement the submittal that the Applicant has
10 made to receive a Certificate of Compliance.

11 Q. Did you have a proceeding pending before
12 the NRC at that time to receive a Certificate of
13 Compliance?

14 DR. SINGH: Yes. At that time we did
15 have our HI-STORM system under review by the NRC
16 for certification.

17 Q. And this was the same certification
18 proceeding that NRC was going through to determine
19 whether they should grant you the certification for
20 the HI-STORM?

21 DR. SINGH: That is correct.

22 Q. Had you, prior to receiving this letter,
23 made licensing submittals to the NRC with respect
24 to this certification?

25 DR. SINGH: Yes, we had.

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1 Q. And would your submittals be analogous
2 in form to the filings that PFS has made before the
3 NRC in connection with the licensing of this
4 facility?

5 DR. SINGH: It would be similar, yes.

6 Q. Now, were the comments or questions
7 raised by the NRC on this RAI directed at any
8 technical report prepared by Holtec similar to
9 Exhibit 225 and others that Holtec has prepared in
10 this proceeding?

11 DR. SINGH: No. These did not pertain
12 to any calculation packages that we had provided to
13 the NRC.

14 Q. So would you say that the questions and
15 comments to the NRC was raising with you were
16 directly relating to portions or elements of your
17 licensing submittal?

18 DR. SINGH: That is correct.

19 Q. And none of them referred to any
20 document that had been prepared by your technical
21 staff and reviewed and approved following your QA
22 proceedings; is that correct?

23 DR. SINGH: Well, it referred to the
24 licensing report, to that extent it did, but not to
25 the calculation packages similar to Exhibit 225 and

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1 other calculation packages that the Board had seen
2 proposed by Holtec.

3 Q. If I remember the exchanges yesterday,
4 this conclusion was used by Mr. Soper in response
5 to or probing into your claim that there had never
6 been an instance in which a calculation prepared by
7 Holtec had to be revised because there was an error
8 that changed the conclusions of the results. Do
9 you remember that conversation?

10 DR. SINGH: Yes. I remember that, yes.

11 Q. Is that conclusion true in light of
12 Exhibit 198?

13 DR. SINGH: My assertion that I made to
14 Mr. Soper yesterday remains unchanged by this
15 letter from the NRC.

16 Q. Now, why is that?

17 DR. SINGH: Because this particular
18 letter was a dialogue between the Applicant and the
19 regulator with respect to the content of the
20 licensing submittal. It did not bear upon the
21 accuracy or the methodology and so on of our
22 calculations.

23 Q. Have you ever received a letter from the
24 NRC with respect to a QA approved calculation in
25 which again the NRC raised issues with respect to

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1 the conclusions of the methodology that you used?

2 DR. SINGH: Well, we have had
3 discussions with the NRC on methodologies, but at
4 no point have we had to withdraw a calculation
5 package because it contained errors and led to
6 changing the conclusions.

7 Q. Thank you. Let me turn to you now, Dr.
8 Soler. I want to ask you a few questions relating
9 to what was introduced yesterday as State Exhibit
10 199. Do you have that with you?

11 DR. SOLER: Yes.

12 Q. Do you have that with you?

13 DR. SOLER: Yes, I do.

14 Q. My understanding is that State Exhibit
15 199 is a copy of a summary of a presentation that
16 you made at a meeting regarding the methodology and
17 use of the DYNAMO computer code; is that correct?

18 DR. SOLER: That is correct. This
19 summary was printed in the proceedings.

20 Q. If I remember your examination by Mr.
21 Soper yesterday, he also asked you to play on your
22 computer a movie of a simulation that you have
23 prepared; is that correct?

24 DR. SOLER: That's correct.

25 Q. And you explain to Mr. Soper that that

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1 simulation was a computer run with the
2 VisualNastran of the behavior of a HI-STAR cask in
3 an earthquake; is that right?

4 DR. SOLER: That's correct.

5 Q. If I remember correctly, that
6 VisualNastran program showed that that HI-STAR cask
7 started showing these deflections and ultimately
8 tipped over, correct?

9 DR. SOLER: That's correct.

10 Q. And that simulation, the movie was, in
11 turn, a reproduction of the actual computer code
12 results that VisualNastran came up with; is that
13 right?

14 DR. SOLER: That's correct. It was
15 directly generated from VisualNastran.

16 Q. Now, so the record is clear, that
17 VisualNastran run was not for the HI-STORM casks
18 that are used at PFS; is that right?

19 DR. SOLER: That's is correct.

20 Q. And the input parameters that went into
21 that run are different from the ones you utilized
22 in your PFS analysis?

23 DR. SOLER: That's correct.

24 Q. And so that particular simulation
25 doesn't say anything in itself about how the

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1 HI-STORM casks to be proposed to be placed at the
2 PFS will behave in a seismic event; is that
3 correct?

4 DR. SOLER: That is correct.

5 Q. Now, let's just go back and think about
6 that simulation for a second. Did that simulation
7 show that the HI-STAR cask exhibited rocking
8 behavior?

9 DR. SOLER: Yes, it is.

10 Q. Did that simulation show that the
11 HI-STAR cask exceeded this precession?

12 DR. SOLER: Yes, it did.

13 Q. Did that simulation show that that cask
14 lacked excursions?

15 DR. SOLER: Yes, it did.

16 Q. And did that simulation, as you said a
17 moment ago, also show that a cask ultimately fell
18 over?

19 DR. SOLER: Yes, it did.

20 Q. With some noise that you added, I think
21 you said?

22 DR. SOLER: Yes. The noise was mine.

23 Q. So does that simulation demonstrate that
24 the VisualNastran program is capable of predicting
25 other things in appropriate case?

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1 DR. SOLER: Yes, it does.

2 Q. And this is the same VisualNastran
3 program that you used for your PFS analysis; is
4 that right?

5 DR. SOLER: Yes. Except for the fact
6 that possibly we may have used an earlier revision
7 of it depending on the date. We are constantly
8 QAing the latest version of the program. So
9 depending on the date of that run, it may have been
10 an earlier revision. But we constantly update our
11 QA versions of that code.

12 Q. And so the ones that you used for PFS,
13 if anything, are more recent rates?

14 DR. SOLER: That is correct. Although
15 with the time frame involved, I suspect there was
16 some crossover.

17 Q. Now, is it correct to say that in none
18 of the VisualNastran runs that you performed for
19 the PFS casks did the program predict any of the
20 large excursions, deflections, precessions or
21 movements that you see in the simulation that you
22 showed yesterday?

23 DR. SOLER: In any of the runs,
24 regardless of the parameters chosen, we never saw
25 excursions, rotations to the extent that we came

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1 anywhere near implying that a cask would tip over.

2 Q. And your answer includes all the runs
3 reported in Exhibit 225 in which you reproduce or
4 utilized the same input data that Altran used in
5 theirs?

6 DR. SOLER: That is correct.

7 Q. Has the VisualNastran runs that you had
8 conducted for this design basis earthquake at PFS
9 shown to your satisfaction that the HI-STORM casks
10 at the PFS have large margins against tipping over?

11 DR. SOLER: They have extremely large
12 margins against tipping over.

13 Q. I have a couple more things for you, Dr.
14 Soler. At first Dr. Khan testified yesterday in
15 rebuttal that the simulations that you presented
16 that shows three balls falling down and then three
17 casks falling down are not meaningful because you
18 pick a large enough value of damping, the energy of
19 the system will be largely absorbed by the
20 collision process. Do you remember that testimony?

21 DR. SOLER: Yes, I do.

22 Q. Is Dr. Khan's testimony correct?

23 DR. SOLER: No.

24 Q. Why not?

25 DR. SOLER: It's my understanding of

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1 what he was saying is that the elastic deformations
2 during the impact would absorb energy depending
3 upon the stiffness values. My conclusion from that
4 is if the two impacting bodies are indeed elastic,
5 no matter how much energy they absorb during the
6 collision process, they give it all back as soon as
7 the motion is reversed and that is equivalent to a
8 coefficient of restitution of 1.

9 Q. And what information do you have --

10 JUDGE FARRAR: Wait a minute. I'm
11 sorry, would you read the answer back, please?

12 (Answer read back as follows:)

13 " A It's my understanding of what
14 he was saying is that the elastic
15 deformations during the impact would
16 absorb energy depending upon the
17 stiffness values. My conclusion from
18 that is if the two impacting bodies are
19 indeed elastic, no matter how much
20 energy they absorb during the collision
21 process, they give it all back as soon
22 as the motion is reversed and that is
23 equivalent to a coefficient of
24 restitution of 1."

25 JUDGE FARRAR: Thank you.

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1 Q. (By Mr. Travieso-Diaz) And were you, in
2 your last answer, you are trying to -- you were
3 talking about using the transposition; is that
4 right?

5 DR. SOLER: What I was reproducing in
6 the simulation was to demonstrate the effect of
7 coefficient of restitution choice on the behavior
8 of either one of those systems, and by doing a
9 triple model and one simulation you could
10 graphically see the difference in your choice of
11 coefficient of restitution.

12 My reason for doing those simulations
13 was to tie coefficient of friction to something
14 that is physically meaningful to a casual observer,
15 whether he has scientific training or not by
16 simply, if you will, relating a technical quantity
17 called the coefficient of restitution to the number
18 of bounces that one would observe if you dropped
19 either one of these models.

20 Q. Before I ask you that question, I
21 believe you refer at one point in your last answer
22 to coefficient of friction. Did you mean to say
23 coefficient --

24 DR. SOLER: I meant coefficient of
25 restitution if I said coefficient of friction.

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1 Q. Thank you. What I'm trying to do is tie
2 the concept of coefficient of restitution to
3 reality. If I remember your testimony, you
4 indicated that 1 percent damping that Dr. Khan
5 suggested we should use is equivalent to having a
6 very high coefficient of restitution?

7 DR. SOLER: That is correct.

8 Q. And in the case of your balls, it shows
9 a ball bouncing 73 times before it essentially
10 comes close to a rest?

11 DR. SOLER: That is correct.

12 Q. And when you use 40 percent it bounces
13 only twice or so?

14 DR. SOLER: Two, maybe three times.

15 Q. In your view, what is the better
16 representation of what, based on your experience,
17 would happen in reality if a cask were to impact a
18 concrete pad?

19 DR. SOLER: On the basis of my
20 experience, I would not expect a cask to bounce
21 that many times. I would expect it to bounce maybe
22 two or three, maybe four. So in my view, a choice
23 of a number around 40 percent of critical damping
24 is correct.

25 Q. So a different way of putting it is that

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1 perhaps in reality the number might not be 40
2 percent, but it is extremely unlikely that would be
3 as low as 1 percent?

4 DR. SOLER: That is a correct reference.

5 Q. Thank you. Moving on to something else,
6 there was a lot of discussion yesterday both by you
7 and by Mr. Khan about the use of beam elements and
8 nodes in VisualNastran, Nastran and DYNAMO. I
9 think you testified that VisualNastran really
10 doesn't use beam elements or nodes. Could you
11 explain a little bit more about what the
12 significance of this is?

13 DR. SOLER: All right. VisualNastran in
14 its effort to solve a dynamics problem goes right
15 to the heart of the matter and says everybody that
16 I'm going to simulate, "I" being the program, if
17 you'll allow me that leeway, I am going to
18 represent as a rigid body having only 6 degrees of
19 freedom. A classical finite element program,
20 similar to what Dr. Khan used, does not have that
21 ability to directly represent a rigid body.

22 Finite element programs are directly
23 designed primarily to measure stress in deformation
24 in their structural mode and, therefore, they
25 require as immediate input, no matter what problem

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1 you are trying to simulate, be it flexible or
2 stiff, that you must define the body first by a
3 series of nodes and then connect those nodes by
4 elements, either beam elements or shell elements or
5 solid elements, depending upon what you represent.

6 If you then have that model and wish to
7 represent a rigid or nearly rigid body within the
8 confines of the finite element program you're
9 working with, you either assign properties like
10 moments of inertia or Young's modulus to the
11 elements you're choosing that are so large that
12 they represent these beam elements or shell
13 elements or solid elements as stiff.

14 Some of the finite element programs go
15 to far as to say, after you define this body by
16 means of nodes and elements, we will allow you to
17 introduce a series of constraint relationships
18 which tie all of these nodes together and say, for
19 instance, if you used 1,000 nodes to represent your
20 body, and each of those nodes has three
21 displacement degrees of freedom so that you
22 initially are starting off representing your body
23 by 3,000 degrees of freedom, by means of a simple
24 command to invoke a constraint relationship, it
25 takes all of those 3,000 degrees of freedom,

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1 reduces it to 6 degrees of freedom representing the
2 motion of the entire assemblage of beams, plates,
3 shells, whatever you use, as a single rigid body.

4 I don't know whether SAP 2000 has that
5 capability. It's primarily a capability to reduce
6 solution time and, therefore, cost of solution, but
7 I would presume that Dr. Khan did what he had to do
8 by putting in the appropriate material properties
9 on his beam elements to make those beam elements
10 represent this very stiff HI-STORM structure.

11 And as an aside, in the course of our
12 licensing effort we've had to make calculations of
13 our estimates of lowest frequencies of beam type
14 response of the cask system, in the case I'm
15 talking about with the HI-STAR, and we predicted
16 that the HI-STAR, if it acted like a beam, would
17 have a lowest bending frequency in the order of 350
18 hertz and if it acted like a rod its lowest
19 frequency was on the order of 450 hertz. I say
20 that only to indicate that any finite element
21 representation, however it was made, should have
22 appropriate properties so as to indicate and
23 predict that the cask was very rigid.

24 I presume that Dr. Khan did that and,
25 therefore, he properly represented the cask by beam

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1 elements. That net result gave a nearly rigid
2 body.

3 Q. Would a layman's characterization of
4 your last answer be essentially as follows: Whether
5 you use beam elements or nodes or not, it's a
6 matter of the modeling technique you use, but not
7 using them is in itself not a deficiency or defect?

8 DR. SOLER: That is correct.

9 Q. I have one last question for you, then,
10 Dr. Soler. Dr. Khan testified yesterday that you
11 should not exceed in your analysis the recommended
12 values of damping that are set forth in Reg Guide
13 1.61 unless you have test data to show higher
14 values. Do you agree with that testimony?

15 DR. SOLER: No.

16 Q. Why not?

17 DR. SOLER: Reg Guide 1.61 is directed
18 towards structural damping. Our model did not
19 allow any of the bodies to have any elastic
20 characteristics and, therefore, there was no
21 structural damping in our model. All of the
22 damping in our model is in there to represent
23 various physical, observable facts that you see
24 during an impact problem. Like it doesn't bounce
25 back as far. If something were to impact another

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1 body, you would hear noise. All of those phenomena
2 dissipate energy, and that's what we're trying to
3 represent with the damping values that we used.

4 MR. TRAVIESO-DIAZ: I have no further
5 questions at this time.

6 JUDGE FARRAR: Dr. Singh, you a few
7 minutes ago explained why, in your view, you don't
8 need shake table tests and you talked about how
9 relatively easy, using the NASA comparison, it is
10 to apply the laws of motion.

11 Are you equally confident about the
12 portion of this whole equation that deals with the
13 input of the forces from the earthquake? In other
14 words, it's one thing to say, okay, given the
15 earthquake I can tell you how the casks are going
16 to move and I don't need a shake table to test
17 that. And the State may or may not agree with your
18 position, but I understand what you're saying.

19 Where do we get, if we were to subscribe
20 to your view, where do we get out of this a similar
21 assurance, given the lack of testing about the
22 earthquake force input?

23 DR. SINGH: Let me try to give you --

24 JUDGE FARRAR: Because it all comes down
25 to that, right?

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1 DR. SINGH: Yes.

2 JUDGE FARRAR: If we're wrong on what
3 the forces of the earthquake are, all the rest of
4 it falls?

5 DR. SINGH: Absolutely.

6 JUDGE FARRAR: Along with the cask.

7 DR. SINGH: Right, right, right. Let me
8 share with you how I see it. The earthquake
9 generated by Geomatrix is extremely conservative in
10 the sense that earthquakes, their nature, their
11 characteristic. There's an excellent publication
12 from Oakridge, it goes back to the mid 70s, called
13 "Nuclear Reactors and Earthquakes." It's got a
14 very good description of what earthquakes are like,
15 the kind of characteristics they should have,
16 limitations they have and so on.

17 Not to promote my own book, but there is
18 in my book on heat exchangers and precession
19 components, there is a chapter on earthquakes and
20 it describes their characteristics. They are there
21 also, and there are many other books, of course.

22 An earthquake, by its natural
23 characteristic, does not have energy content. It's
24 essentially a low frequency event. It does not
25 have energy content above 25 hertz. Most of the

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1 energy is concentrated below 10 hertz. Depending
2 on the geotechnical characteristics of the site,
3 the energy content or frequency of which the energy
4 is concentrated, but in a real earthquake you don't
5 have an input, an energy spectrum that extends
6 beyond, say, 25 hertz. It's considered pretty much
7 the upper limit.

8 Earthquakes have some wonderful
9 characteristics that will make you believe in God
10 if you really understand them. They have some
11 unbelievable characteristics all over the world.
12 And that book that I mentioned before, the Oakridge
13 book published by Oakridge gets into those. The
14 earthquake that Geomatrix had produced, as Dr. Khan
15 shows in his response curves, you can see the
16 energy goes all the way out to 100 hertz.

17 The people at Pacific Gas & Electric,
18 who are always dealing with earthquakes, they spend
19 a great deal of money studying earthquakes, their
20 experts looked at the earthquake generated for PFS
21 and they said they would have never done something
22 like this, it is too darn severe. The artificial
23 time histories generated are extremely severe.
24 PG&E informed me after they saw PFS's earthquake.

25 My general sense based on, and I have

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1 worked with earthquakes at at least 60 nuclear
2 plants in this country, this artificial time
3 history that Geomatrix has generated is extremely
4 conservative. And I would think that there is a
5 great deal -- I would suspect, perhaps is a better
6 word because I did not generate them myself, that
7 the earthquakes generated 2,000, 10,000 year, 1,000
8 year, they are all laden with considerable
9 conservatism.

10 MR. TRAVIESO-DIAZ: Could I ask a
11 couple of clarifying questions to follow-up on
12 yours?

13 JUDGE FARRAR: In a second. But
14 notwithstanding that that's your opinion and the
15 hearsay opinion of other experts, none of this
16 earthquake modeling is as tested and proven as
17 Newton's laws of motion? In other words, all of
18 you in the field believe it?

19 DR. SINGH: I would not --

20 JUDGE FARRAR: But where is the skeptic?
21 The skeptic just has to look at your opinion and
22 say, these are the best people, not you personally,
23 but people working on this, these are the experts
24 and that's all we have to do, all we have to go on?

25 DR. SINGH: Generating earthquakes is

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1 certainly not founded on the kind of absolutely
2 rock solid principles that the cask analysis is
3 founded on, no question. Newton's laws of motion
4 are absolutely unimpeachable. In generating an
5 earthquake, if you gave it to two companies to do
6 it, you would probably get two different
7 earthquakes. They may both be conservative, but
8 you will get two different earthquakes.

9 JUDGE FARRAR: We have talked about
10 Hertz in the past counsel of days and he also did
11 some work on electromagnetisms and so forth. And
12 if I recall my history of that, leading through the
13 theories of physics developing from the early 20th
14 Century through now, a lot of the world's leading
15 experts on that were wrong on what electromagnetic
16 waves are and what gravity is and so forth. How do
17 we know that you all are right?

18 DR. SINGH: Well, the nature of
19 electromagnetic waves, the fundamental
20 understanding has not changed. Particle,
21 subparticle nuclear physics, that had changed.

22 JUDGE FARRAR: There were a lot of
23 people wrong along the way.

24 DR. SINGH: Well, you know, strictly
25 speaking, strictly speaking, Newton's laws were

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1 modified by Einstein. At very high speeds mass
2 does change. But for the physical world in which
3 the, for example, the cask evaluation is founded,
4 Newton's laws of motion have not been -- cannot be
5 modified.

6 The second law of thermodynamics
7 developed by Clausius back in the 1700s, I believe,
8 has not changed. Now, these basic foundations on
9 which science rests have not changes. There have
10 been changes in the 20th Century in the arcane
11 aspects of subparticle physics, but the basic
12 nature of waves, and light consists of waves, that
13 hasn't changed. And I think we are not here into a
14 structure or system or problem that touches on
15 frontiers of science, we are really in the
16 mainstream of everyday engineering. There should
17 be no uncertainty in that matter.

18 JUDGE FARRAR: Thank you, Dr. Singh.
19 Mr. Travieso-Diaz, you were going to --

20 MR. TRAVIESO-DIAZ: Yes. Maybe this
21 will help a little bit, hopefully.

22 Q. (By Mr. Travieso-Diaz) Dr. Singh, if
23 you were asked to design, to devise a shake table
24 test to determine the performance of this cask in
25 an earthquake, what would you use for your

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1 earthquake?

2 DR. SINGH: For which earthquake?

3 Q. Design basis earthquake.

4 DR. SINGH: I will presumably use the
5 design basis earth wake provided, which would be a
6 combination of design waves.

7 Q. Would that be the time histories that
8 you were talking about a moment ago that Geomatrix
9 prepared?

10 DR. SINGH: That's right. Unless
11 somebody else provides something else.

12 Q. So if, and I think the basic assumption
13 of the question the Chairman asked, "Why we are
14 wrong? Why the earthquake is bigger? In doing a
15 shake table test using the same earthquake as
16 you're utilizing won't get you in a better
17 position, would it?

18 DR. SINGH: That is true. I should also
19 add to --

20 JUDGE FARRAR: And that, I think my last
21 question, I mean, I understand that, that the shake
22 table is only whatever, its other advantages or
23 disadvantages, the shake table is only as good as
24 the earthquake going in. That's why my last
25 question focused on the earthquake going in.

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1 MR. TRAVIESO-DIAZ: In fact, could I ask
2 one more?

3 DR. SINGH: Can I finish answering the
4 question first just for a second?

5 MR. TRAVIESO-DIAZ: Yes.

6 DR. SINGH: You know, the design of the
7 cask just for the record we should make it clear,
8 that we not only analyzed the response to a
9 prescribed earthquake, but we also, in NRC's
10 euphemism, do a non-mechanistic evaluation. The
11 non-mechanistic is a counterfactual postulate where
12 the cask actually tips over. So after showing that
13 it does not tip over then we proceed to postulate
14 that it does tip over and we show that the fuel
15 assembly remains unchanged even though in the real
16 world who really cares what happens inside the
17 waste package. But we have to show to the NRC that
18 the fuel assembly is not damaged, we show to the
19 NRC that the waste packet, the canister is
20 unaffected, and that the cask maintains its
21 shielding capability. So all these are additional
22 layers of safety that the regulator imposes on the
23 system.

24 JUDGE FARRAR: And that's a question
25 that we're going to take up, or a sub issue that we

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1 take up later.

2 MR. TRAVIESO-DIAZ: Correct. If I could
3 ask one more question on the same lines?

4 Q. (By Mr. Travieso-Diaz) Isn't it true
5 that Holtec performed a number of computer
6 simulations using beyond design basis earthquake,
7 using the 10,000-year earthquake as the input?

8 DR. SINGH: That is correct.

9 Q. And you showed or your results of your
10 computer analysis showed that the cask will not tip
11 over even in those earthquake levels; is that
12 correct?

13 DR. SINGH: We have shown it would not
14 tip over; we have shown that it would not tip over
15 with large margins.

16 Q. Would that give you some additional
17 confidence that even if your design basis
18 earthquake is missed by some you still have enough
19 money in your design to take a bigger earthquake?

20 DR. SINGH: That is correct.

21 JUDGE LAM: I had a question for Dr.
22 Soler.

23 Dr. Soler, in your rebuttal testimony to
24 Dr. Khan's work, I had heard and read numerous
25 reasons that you had given that Dr. Khan's work was

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1 not adequate. Let me recap what my understanding
2 is of your rebuttal testimony and ask you to either
3 add or detract from it.

4 My understanding is your critique of Dr.
5 Khan's work, specifically on this very large
6 displacement, I think this is Case No. 3 in Table
7 3, when Dr. Khan's work resulted in about 40 feet
8 of displacement and about 2 feet above the ground.

9 DR. SOLER: Uh-huh (affirmative).

10 JUDGE LAM: My understanding of your
11 rebuttal is, one, SAP 2000 is a deflection, a small
12 deflection program. Therefore, any large
13 displacement results should be an immediate concern
14 to any analyst who is using the program. That's
15 reason number 1.

16 Reason number 2 is that 1 percent
17 damping is too low. Reason number 3 is that a
18 contact stiffness of 1 million pounds per inch is
19 too low. Beyond these three reasons, are there any
20 more?

21 DR. SOLER: Well, if I may, our original
22 thought on the program was that the problem lie in
23 the choice of the unrealistic values for stiffness
24 and damping. But having run our simulation with
25 the same unrealistic values of stiffness and

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1 damping, and predicting a perfectly reasonable and
2 adequate behavior of the cask, the only real
3 problem that I have is, of course, the inability of
4 the program that he used to predict any kind of
5 meaningful results when the deflections and
6 rotations exceeded a relatively small value.

7 So I don't know the reason why the
8 deflections or the motion of this cask in Dr.
9 Khan's model went to such large values, but the
10 fact that the program itself is not applicable to
11 that kind of a motion leads me to believe that
12 that's the primary reason. And his use of small
13 values, of unrealistic values of stiffness and
14 damping are merely secondary.

15 JUDGE LAM: So this is your latest
16 thought on --

17 DR. SOLER: Yes. I believe -- I have no
18 experience with SAP 2000, but as a reviewer, if you
19 will, the first question I would ask is something
20 doesn't seem right. It just doesn't. I guess the
21 simplest way to say it is I don't know what the
22 answer is, but I'll know it when I see it. And
23 when I saw that, my immediate first reaction is
24 something is wrong.

25 JUDGE LAM: Thank you, Dr. Soler.

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1 JUDGE FARRAR: Does the Staff have any
2 recross?

3 MR. O'NEILL: I guess just one for
4 recross, just one quick follow-up question that
5 relates to what Dr. Lam said.

6

7

RECROSS-EXAMINATION

8

BY MR. O'NEILL:

9 Q. Didn't you also express a concern
10 regarding Dr. Khan's model, concerning its
11 inability or asserted inability to duplicate a
12 simple known classical solution?

13 DR. SOLER: Well, that has to do with
14 his choice of various stiffness values. And
15 initially, and initially being from the first time
16 I got the report to read, my first thought was it's
17 the values he'd chosen because the report didn't
18 quite tell you the capabilities of the program.

19 But after reading the user manual and
20 after hearing some of Dr. Khan's own testimony and
21 admissions that he knew the program was a small
22 deflection program, I began to refine and focus my
23 thinking as to exactly what the problem could have
24 been. Because all along I would simply say, having
25 done a lot of finite element analyses, that

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1 something was wrong with that particular solution.

2 Your immediate focus was on his values
3 and parameters. As I gained more information, my
4 focus began to say that the program just isn't
5 suitable. And that's why we undertook to use
6 VisualNastran, to see whether or not it's a problem
7 with the input parameters or whether it's simply a
8 problem and the program can't handle the
9 capabilities.

10 And having gotten the results we got in
11 Exhibit 225, I'm more inclined to say that the
12 reason he's getting 30 feet, 40 feet is not his
13 choice of parameters, but the fact that the program
14 is inapplicable to predict things. Once they get
15 too large it just-- I'll use the word "blow up,"
16 but not in the terms that solutions go to infinity
17 or the program stops. That may be one sign of a
18 program blowing up, but it's not the only sign.

19 The fact that his particular methodology
20 for choosing various stiffnesses wouldn't reproduce
21 certain classical problems, that is simply a
22 modeling problem. It's entirely different from
23 using an inappropriate program and trusting these
24 results as if they were cast in stone.

25 MR. O'NEILL: Thanks for that

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1 clarification. That's it.

2 JUDGE FARRAR: Thank you, Mr. O'Neill.
3 Mr. Soper, would you like to do additional cross
4 before or after lunch?

5 MR. SOPER: Before.

6 JUDGE FARRAR: Okay. Then go ahead.

7

8 RE-CROSS-EXAMINATION

9 BY MR. SOPER:

10 Q. Dr. Soler, Dr. Khan's report has 20
11 cases listed. You only tried to run one of those
12 cases for a check; isn't that right?

13 DR. SOLER: That is correct.

14 Q. And if you truly believe that SAP 2000
15 has some limitation causing a result you didn't
16 like, you could have simply run each one of those
17 on SAP 2000, looked at them to see if you got the
18 right answer. But you don't do that, did you?

19 DR. SOLER: That's correct. May I
20 elaborate a little?

21 Q. No. And that would have been easy to
22 do, would it not? If you did not know how to do it
23 yourself, you say you don't know how to run SAP
24 2000, you could ask -- I don't know how many
25 engineers at Holtec, or you could somebody, but if

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1 you wanted some conclusive evidence that, in fact,
2 there was something wrong with it you wouldn't run
3 a different example on a different computer, you
4 would run the same 20 sets of cases on the same
5 computer and then concluded that. But you didn't
6 do that, did you?

7 DR. SOLER: I can't answer that yes or
8 no.

9 Q. Well, did you do that?

10 DR. SOLER: I am willing to admit that
11 if I took SAP 2000 and I took the input model of
12 Dr. Khan, either directly given to me or developed
13 from what I knew from his report and had someone
14 run it on SAP 2000, run all of those cases, I am
15 fairly confident that I would have gotten exactly
16 the same results in these tables no matter how many
17 runs I did.

18 Q. Now, you also have an in-house program
19 called DYNAMO which you admit is similarly limited
20 to small rotations, is it not?

21 DR. SOLER: That is correct.

22 Q. And when you run things on it everything
23 is not inaccurate, is it?

24 DR. SOLER: As long as the deflections
25 you predict are not too large, I am willing to

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1 stand by the results of that program.

2 Q. Precisely. So you can look at the case
3 and you can look at the results and you can give a
4 judgment that in spite of the fact that it's small
5 rotations, the results are valid?

6 DR. SOLER: That's correct.

7 Q. And you could do the same thing with SAP
8 2000, could you not?

9 DR. SOLER: That is correct.

10 Q. You also testified a moment ago that you
11 picked damping values based on what is physically
12 observable in the real world; is that correct?

13 DR. SOLER: That would be a correct
14 representation.

15 Q. And I think in giving that answer you
16 had reference to the bouncing balls and bouncing
17 casks; is that right?

18 DR. SOLER: Yes.

19 Q. And they don't bounce like that, do
20 they?

21 DR. SOLER: I could devise a experiment,
22 say, with a hard steel ball against a hard steel
23 surface and, in fact, make it bounce many more
24 times than I would expect a cask to bounce on the
25 ground with the surfaces we're talking about.

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1 Q. Have you ever seen in the real world a
2 180-ton concrete cask on a concrete pad during an
3 earthquake?

4 DR. SOLER: Those specific ones, no, I
5 have not.

6 Q. Or a movie of the same?

7 DR. SOLER: No, I have not.

8 Q. I see. And you wouldn't expect the cask
9 to simply move up and down without movement from
10 side to side, would you?

11 DR. SOLER: No. I would expect a
12 combination of motions.

13 Q. And it would rock from side to side
14 probably?

15 DR. SOLER: Depending on the earthquake,
16 yes.

17 Q. And the earthquake would change in
18 frequency and intensity during the 30 seconds or so
19 that it lasts? You would expect that, would you
20 not?

21 DR. SOLER: It would be a combination of
22 frequencies and whatever the peak intensity was, I
23 would expect it would reach that.

24 Q. And you have never seen such a thing
25 yourself, have you?

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1 DR. SOLER: Are we talking about casks
2 or --

3 Q. Casks, yes, sir.

4 DR. SOLER: I have never been standing
5 on a pad when an earthquake happened and a cask
6 rocked.

7 Q. Well, my question is, have you seen one?
8 I don't care if you stood there or not.

9 DR. SOLER: Well, I would surmise if I
10 didn't stand there I didn't see it. So I will say
11 I have not seen a cask rock during an earthquake.

12 Q. Dr. Singh, sir, you referred to some
13 Japanese test data that you say is inaccurate or
14 otherwise not acceptable data in some way. Did I
15 understand you right, sir?

16 DR. SINGH: No, I didn't say that.

17 Q. Did you have any reference to Japanese
18 test data at all?

19 DR. SINGH: I gave some testimony on
20 Japanese test data, but I didn't say what you said
21 about it.

22 Q. Well, what did you say about it?

23 DR. SINGH: I basically said they had
24 conducted some limited tests and the tests were not
25 meaningful for correlating with an analytical

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1 solution -- or numerical solution, I'm sorry.

2 Q. Now, I see that in your -- now I'm
3 referring to Exhibit 197, Bates number of 47930.
4 It's a letter signed by you dated March 5, 1998. I
5 see in that letter that there is a, on page 2, a
6 list of items and costs associated for those items.
7 Excuse me. Let's go back to page 1.

8 DR. SINGH: Okay.

9 Q. Item I, Comparison with Japan test data.
10 Now, would this be the test data that you were
11 referring to that is not meaningful for calibrating
12 a model?

13 DR. SINGH: I believe so. I don't have
14 an adequate recollection of which data we're
15 talking about then, but I believe it's the same
16 data.

17 Q. I see. And in this letter you were
18 writing to PFS and recommending that you, in fact,
19 used this test data and gave a price for applying
20 it to the PFS situation; is that correct?

21 DR. SINGH: Well, the Japanese -- I
22 wouldn't characterize it that way. The Japanese
23 test data, there was a possibility it would become
24 available. And if it were to become available with
25 the appropriate documentation, then a possibility

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1 existed to make use of it.

2 Q. I see. But at some point you decided
3 that the information was not accurate, is that
4 right, or not, excuse me, not helpful in validating
5 your calculations? Is that a fair assessment of
6 what your thoughts were?

7 DR. SINGH: Well, that's been my
8 testimonies on the record. But when, at which
9 point I came to that conclusion, I don't precisely
10 remember. Realize that this was one of a -- one of
11 those obscure developments that goes on week after
12 week at our company.

13 This letter, just to give you
14 perspective, we put out on a typical -- in a
15 typical week, I would say between 10 to 20 letters
16 that goes out on various projects for various
17 project managers. This is one of them. I don't
18 have detailed recollection of what went on and what
19 we were contemplating at the time. An awful lot of
20 events have occurred since then and this is a --
21 this is historical artifact, and to the extent that
22 I didn't even remember that a letter was written.

23 Q. This artifact, however, bears your
24 signature, does it not?

25 DR. SINGH: Of course. You will see

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1 letters from me going back to 1970 that bear my
2 signature.

3 Q. And the test data that we're talking
4 about here, in fact, was shake table tests, was it
5 not?

6 DR. SINGH: That's what you showed me
7 yesterday so I believe it was.

8 Q. You testified a little earlier that
9 shake tables have, I think you said, a place in the
10 sun only for small equipment with close tolerances.
11 Is that an accurate restatement of your testimony?

12 DR. SINGH: That's reasonably close,
13 yes.

14 Q. I take it you meant to exclude large
15 items from the appropriateness for testing on a
16 shake table by that statement?

17 DR. SINGH: Well, that statement wasn't
18 by itself exclusionary of large components. I gave
19 additional testimony where I explained that a large
20 component with friction as the -- in other words, a
21 free-standing component with friction as the
22 lateral force provider during an earthquake event,
23 and with significant internal impact damping during
24 an earthquake, a shake table is not appropriate.
25 There were many reasons. These were some of them.

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