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Official Transcript of Proceedings
NUCLEAR REGULATORY COMMISSION

Title: Private Fuel Storage, LLC

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

Location: Rockville, Maryland

Date: Tuesday, June 18, 2002

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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
)

ASLBP Hearing Room
Third Floor
Two White Flint North Building
11545 Rockville Pike
Rockville, Maryland

Tuesday, June 18, 2002

The above-entitled matter came on for hearing,
pursuant to notice, at 9:00 a.m. before:

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

~~THE HONORABLE G. PAUL BOLLWERK, III
Administrative Judge
U.S. Nuclear Regulatory Commission~~

DR. JERRY R. KLINE
Administrative Judge
U.S. Nuclear Regulatory Commission

DR. PETER S. LAM
Administrative Judge
U.S. Nuclear Regulatory Commission

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E-X-H-I-B-I-T-S

EXHIBITS

<u>NUMBER</u>	<u>DESCRIPTION</u>	<u>MARK</u>	<u>RECD</u>
<u>Applicant</u>			
230	SAR 2.6-42 to 2.6-44b	11173	11185
228	Mitchell Deposition		11185
228A	Mitchell Deposition w/corrections		11185
231	Calculation	11276	11277
232	Settlement Analysis	11276	11277

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

9:05 a.m.

1
2
3 CHAIRMAN FARRAR: On the record. Good
4 morning. We are ready to resume Dr. Barlett and Dr.
5 Mitchell if there are no preliminary matters.

6 MR. TRAVIESO-DIAZ: I reflected over the
7 state of the schedule and the state of the record on
8 soil-cement issues. I came reluctantly to the
9 conclusion that the overall progress of this matter
10 will be served by not having the therma-calculation
11 brought in and not taking an hour or hour and a half
12 or whatever time it would take to examine Dr. Singh on
13 it.

14 I want to make clear that it doesn't
15 indicate on my part that there is any weakness on the
16 testimony. I'm doing it because we are operating
17 under schedule constraints. Dr. Wissa has a 6:00 p.m.
18 plane which means he has to be out of here I think no
19 later than 4:00 p.m. and perhaps earlier which again
20 tells me we should finish soil-cement by that time.

21 With all these concerns in mind what I
22 would like to do is finish soil-cement and to the
23 extent that time permits move into Mr. Trudeau's
24 rebuttal testimony on Section D which is the logical
25 thing to take off at this point.

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1 CHAIRMAN FARRAR: So in that circumstance
2 we don't need to have Dr. Singh in by video or
3 teleconference after lunch.

4 MR. TRAVIESO-DIAZ: Correct.

5 CHAIRMAN FARRAR: All right. In terms of
6 scheduling we certainly appreciate that.

7 MR. TRAVIESO-DIAZ: It's the art of the
8 possible.

9 CHAIRMAN FARRAR: Okay.

10 MR. TURK: What does that do to PFS
11 Exhibit 229 then? Is it a problem?

12 MR. TRAVIESO-DIAZ: It's just there. We
13 won't move it into evidence.

14 CHAIRMAN FARRAR: You say you will not --

15 MR. TRAVIESO-DIAZ: I don't have any
16 intent unless something happens between now and the
17 end of the day that requires me to revisit the
18 concept.

19 CHAIRMAN FARRAR: Right.

20 MR. TRAVIESO-DIAZ: But as of now I don't
21 intend to move that it be admitted into evidence.

22 CHAIRMAN FARRAR: All right. Any other
23 preliminary matters?

24 MR. TRAVIESO-DIAZ: Not from myself.

25 CHAIRMAN FARRAR: Ms. Chancellor?

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1 (No response.)

2 CHAIRMAN FARRAR: All right. Dr.
3 Mitchell, are you ready to turn in your homework?

4 DR. MITCHELL: Yes sir.

5 CHAIRMAN FARRAR: We appreciate that
6 particularly since I know you've asked a lot of
7 students that in your time. All right, Mr. Travieso-
8 Diaz.

9 Whereupon,

10 DR. JAMES MITCHELL

11 having been previously duly sworn, the witness was
12 examined and testified further as follows:

13 CROSS EXAMINATION (con't)

14 BY MR. TRAVIESO-DIAZ:

15 Q Dr. Mitchell, do you remember when we last
16 spoke yesterday I had asked you to look at Exhibit JJJ
17 which is SAR section 2.6.4.11 and particularly to the
18 first bullet on page 2.6-118? Do you remember?

19 A Yes I do.

20 Q The question that I was going to ask you
21 with respect to that paragraph which by now you have
22 read was that whether you had any reason to believe
23 that the approach that PFS describes in that paragraph
24 to develop an appropriate soil-cement mix would not be
25 successful.

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1 A I believe that the approach could lead to
2 a suitable design, yes.

3 Q And it is also your belief that it should
4 be able to very fast through testing that the adequate
5 shear resistance and the other parameters called for
6 in the design are in fact achieved.

7 A The testing would indicate whether it is
8 possible that they be achieved and this would require
9 test both in the laboratory and in the field.

10 Q Thank you. In the interest of time would
11 you take a look at your deposition which is Exhibit
12 228 and the corrections that go with it? Would you
13 take a look at pages 56 and 57 and first confirm for
14 me that they are no corrections to the testimony on
15 those pages? Is that right?

16 A There are no corrections and I noted that
17 when I reviewed the deposition.

18 Q Thank you. On those pages and I'm going
19 to attempt to summarize what you said but please
20 correct me if I'm wrong you indicated that after
21 reviewing pages 2.6-118 and 2.6-119 of the SAR that
22 you believe that the construction prode (PH) and the
23 PFS intends to implement (Telephone ringing.) and
24 seemed like a reasonable construction procedure. Is
25 that still your view?

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1 A Yes.

2 Q Thank you. If you will turn to Exhibit
3 GGG which is Engineering Services Scope of Work
4 document also known as ESSOW. Do you remember in your
5 deposition we spent some time going through that
6 document? You went through it last night as well.

7 CHAIRMAN FARRAR: Wait a minute and let
8 him find the document.

9 MR. TRAVIESO-DIAZ: Yes.

10 THE WITNESS: I have it.

11 BY MR. TRAVIESO-DIAZ:

12 Q You testified that it appeared to you that
13 the listing of testing standards as American Society
14 of Testing and Materials or ASTM are listed on the
15 ESSOW as controlling documents were the correct
16 standards to follow. Is that still your view?

17 A Yes.

18 Q And with respect to the test themselves
19 you determined then by examining the ESSOW that the
20 tests were appropriate and the manner in which PFS
21 intended to conduct them was consistent with the art
22 of the practice. Is that correct?

23 A It seemed to be. Yes.

24 Q And that's still your view.

25 A Yes.

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1 Q Now there were if I remember when we
2 talked and maybe you can explain this more two tests
3 you thought that were not listed in the ESSOW that you
4 thought should be conducted. You remember that. I
5 can tell you where. Page 70.

6 A Of the transcript?

7 Q Of the transcript. And that again is that
8 a page in which you had corrections?

9 A No.

10 Q To refresh your memory, did you look at
11 page 70 of the transcript?

12 A Yes.

13 Q You started discussing on line 13 one of
14 the tests that you thought should be conducted. Is
15 that right?

16 A About the sliding resistance, yes.

17 Q Could you explain what you meant or what
18 you mean? I presume this to mean that it should be
19 conducted. Is that right?

20 A Could you repeat that question?

21 Q Yes. Am I correct in presuming that you
22 still believe that that test should be conducted?

23 A Yes, that's correct.

24 Q Could you describe that test?

25 A It's a test to determine the strength that

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1 the interfaces between two layers. It could be
2 successive layers of compacted soil-cement. It could
3 be between the soil-cement and the silty clay or the
4 Bonneville clay below. Or it could be between the
5 compacted cement-treated soil and the bottom of the
6 concrete mat.

7 Q Did you hear the discussion yesterday by
8 Mr. Trudeau and Dr. Wissa about this particular test?

9 A Yes.

10 Q Does it appear to you that their approach
11 or the concept as to how they intend to conduct this
12 test is reasonable?

13 A I think so, yes. I haven't seen the
14 details but it seemed reasonable.

15 Q Another test that you mentioned is on page
16 72 of the transcript. Again will you examine it to
17 make sure there are no corrections to your testimony?

18 A It's all right.

19 Q There are no corrections.

20 A No corrections.

21 Q Could you describe for the record the test
22 that you testified on page 72 that you thought should
23 be conducted?

24 A It would be a test for determination of
25 the modulus of the cement-treated soil that's going to

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1 be placed beneath the pads where it's required that
2 the static modulus be less than 75,000 psi.

3 Q Do you still believe that that test should
4 be conducted?

5 A A test in some form should be conducted.
6 I am unable to say the exact details of this test
7 because I am not familiar with the calculation, what
8 went into it, how they converted from a static modulus
9 from an appropriate dynamic modulus which would be
10 required for analysis of the impact. Nor am I aware
11 of how they intend to take into account that the
12 modulus that they measure in any testing program is
13 likely to be quite different than the modulus that
14 will be affected some months or some years later when
15 the pads might be subjected to impact.

16 Q Were you here yesterday when Mr. Trudeau
17 and Dr. Wissa talked about this test?

18 A Yes.

19 Q Is it your understanding that they intend
20 to conduct such a test?

21 A They intend to conduct a test if my memory
22 is correct where they will derive a modulus from a
23 static stress strain curve and a compression test.

24 Q Do you have any problem with their
25 approach?

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1 A I don't have a problem in determining any
2 modulus that way. Where I would have a problem if
3 there is to be a problem is how they would take the
4 results of that and translate them into the modulus
5 that is being used in the calculation so as to
6 appropriately take into account the effects of dynamic
7 loading and time.

8 Q Of course we won't know if there is a
9 problem until they go ahead and actually perform not
10 only the test but translate the test results into
11 actual calculation numbers. Is that correct?

12 A That's correct.

13 Q Assuming that PFS were to conduct those
14 two tests that you just testified about or the ones
15 that are listed in the ESSOW, would you believe that
16 the formulation of the test problem that PFS has come
17 up with is satisfactory?

18 DR. MITCHELL: In general, I would
19 consider it satisfactory, but again, I don't know what
20 happens to some of those numbers as they disappear
21 into the calculations that are being used to support
22 the analyses, because I am not familiar in detail with
23 those analyses, and they're outside the scope of my
24 testimony.

25 MR. TRAVIESO-DIAZ: I'm going to ask you

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1 a question, to ask you to summarize your views on what
2 we have been discussing, and please feel free to
3 either agree or disagree with my summary. My summary
4 of your testimony yesterday and today is as follows.
5 You believe that PFS has developed a reasonable
6 program to qualify through testing an appropriate soil
7 cement mix. Am I right so far?

8 DR. MITCHELL: Yes.

9 MR. TRAVIESO-DIAZ: That PFS has developed
10 a reasonable construction program. Am I right so far?

11 DR. MITCHELL: It appears to be
12 reasonable.

13 MR. TRAVIESO-DIAZ: PFS has developed a
14 reasonable soil cement test program, which is
15 complete, except for the two exceptions that you
16 mentioned, which they have indicated separately that
17 they intend to do.

18 DR. MITCHELL: Yes.

19 MR. TRAVIESO-DIAZ: And PFS is in the
20 process of conducting the test program, but is some
21 distance from finishing it. Is that correct?

22 DR. MITCHELL: They have done limited
23 testing, and as far as the soil cement is concerned,
24 the only results that I have seen so far indicate that
25 the mixes that they have tried have not passed the

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1 test.

2 MR. TRAVIESO-DIAZ: Going back now to
3 answer five of your testimony, that's where we were
4 talking about Point Three. Do you remember?

5 DR. MITCHELL: Here we go.

6 MR. TRAVIESO-DIAZ: Would it be fair based
7 on the testimony you just has given, that your main
8 concern, as is reflected on Point Three, is that even
9 though PFS has developed a test program, it is not
10 complete, it's not finished, and you haven't seen the
11 results that will give you confidence that, in fact,
12 the properties have been achieved.

13 DR. MITCHELL: Could you restate that,
14 please, because I was looking at what was written here
15 as you were speaking.

16 MR. TRAVIESO-DIAZ: I'm sorry. Could you
17 have it read back? I can never repeat myself
18 completely. Actually, I do repeat myself, but not
19 exactly.

20 COURT REPORTER: Yes, I can get that.

21 (Last question read back)

22 THE WITNESS: I have not seen any results.

23 MR. TRAVIESO-DIAZ: And that is your main
24 area of concern at this point.

25 DR. MITCHELL: Yes, it is. If I could

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1 summarize it in a nutshell.

2 MR. TRAVIESO-DIAZ: Please.

3 DR. MITCHELL: It seems to me that the PFS
4 position is trust me -- .

5 CHAIRMAN FARRAR: Wait. Hold on.

6 COURT REPORTER: We're fine.

7 CHAIRMAN FARRAR: Okay. Go ahead.

8 THE WITNESS: Let me restate. It seems to
9 me in this regard that the PFS position is, we have a
10 program, trust me, or trust us. And I believe that
11 the position of the State is you may have a program.
12 Show us.

13 MR. TRAVIESO-DIAZ: All right. And the
14 question, of course -- you heard the question debated
15 yesterday, is it why show us now?

16 DR. MITCHELL: Now, because it seems to
17 me, in any event, that there's a great deal hinging on
18 the successful achievement of the properties, proper
19 construction, and the conditions that are going to be
20 required for the design that has been developed. To
21 be in a position to know that you can do it is, I
22 think, a much better position to be in, than to say
23 you're going to be able to do it at some later time,
24 and then have trouble.

25 MR. TRAVIESO-DIAZ: If I could refer you

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1 back to your deposition transcript, Exhibit 228. And
2 turn to page 58.

3 DR. MITCHELL: Fifty-eight.

4 MR. TRAVIESO-DIAZ: No corrections on that
5 page?

6 DR. MITCHELL: No.

7 MR. TRAVIESO-DIAZ: Okay. I asked you on
8 page 58, "What would be the significance of having PFS
9 not conduct a complete test program before licensing"?
10 And this is what you said. "Well, in the unlikely
11 event that you couldn't obtain the bond that you have
12 designed your project to have yes, it would make a
13 difference."

14 I asked you, "Sure. It will be a terrible
15 waste of time." And your answer was, "Yes."

16 And then we went a little later on page
17 59, I asked you, "Is there any significance to
18 reaching the determination either way, whether it is
19 done today, or whether it is done say just before
20 construction starts?" And your answer is, "Seems to
21 me to be prudent that you would want to demonstrate
22 these things before the final design is completed, and
23 the appropriate licensing to go ahead with the project
24 is issued." Is that still your view?

25 DR. MITCHELL: It is.

1 MR. TRAVIESO-DIAZ: Would it be fair to
2 summarize the testimony then and now as saying that as
3 a technical matter, you think it would be prudent to
4 make this proof at this point?

5 DR. MITCHELL: Yes.

6 MR. TRAVIESO-DIAZ: But you are not
7 passing as to whether from the viewpoint of licensing,
8 that's something that needs or should be done at this
9 point. Is that correct?

10 DR. MITCHELL: Well, in my opinion, it
11 should be done at this point. I'm not familiar in
12 detail with the rules and regulations of licensing,
13 but within the realm of what I would consider to be
14 good engineering practice, now is the time to do it.

15 MR. TRAVIESO-DIAZ: Dr. Bartlett, I don't
16 want you to go to sleep on me. Let me ask you a
17 question. I asked you and Dr. Austin like a similar
18 question during the hearings in Salt Lake City.

19 CHAIRMAN FARRAR: Mr. Travieso-Diaz, hold
20 on. If you don't mind me interrupting --

21 MR. TRAVIESO-DIAZ: No, please.

22 CHAIRMAN FARRAR: -- let me follow-up on
23 that. That opinion you gave, Dr. Mitchell, about when
24 it would prudent to do it, what sort of hat are you
25 wearing when you're giving that opinion? In other

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1 words, is that the opinion you would give if you were
2 the advisor to the applicant, and say -- and urging
3 them don't go too far before we test this out, as a
4 matter of prudent judgment from their business
5 standpoint, or is it with more of a regulator's hat
6 that says, you know, this doesn't make any sense to go
7 ahead until we look at it. Help us. You know, where
8 are you sitting when you make that statement?

9 DR. MITCHELL: I'm sitting as an
10 individual engineer who gets involved in these kinds
11 of projects. And I think over my experience, it's
12 usual to get a good understanding of the properties
13 that you are starting with, and the properties of the
14 materials you hope to have at the end before you've
15 reached a final design phase.

16 CHAIRMAN FARRAR: Okay.

17 JUDGE LAM: Dr. Mitchell, what would the
18 penalty be if they don't do it earlier? Isn't it true
19 the penalty would only be something of a financial
20 nature, because if the application is committed, if
21 they are committed to do the right thing, if they do
22 the test too late, and the consequences would only be
23 that they -- whatever design they have, they need to
24 backfit it. Is this your --

25 DR. MITCHELL: Well, I think that's

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1 basically true, yes, Your Honor. But I think, if I
2 were working as a consultant to that particular group,
3 I would, in good faith, encourage them to pay me now
4 rather than pay me later.

5 JUDGE LAM: So this is a good engineering
6 practice that you are proposing to them.

7 DR. MITCHELL: Yes.

8 MR. TRAVIESO-DIAZ: In fact, I think you
9 said it best in your deposition, didn't you, when you
10 said, "If after you do the testing program, you don't
11 confirm what you have, it will be a terrible waste of
12 time."

13 DR. MITCHELL: Yeah.

14 MR. TRAVIESO-DIAZ: Is that what you have
15 in mind?

16 DR. MITCHELL: Time and money.

17 MR. TRAVIESO-DIAZ: Yes. Thank you.
18 Scratch my question, Dr. Bartlett. I think we have
19 talked about this enough. Let's move on, Dr.
20 Mitchell, to Answer 8 in your direct testimony. It's
21 on page 5. Now Dr. Bartlett and I talked about this
22 in Salt Lake City, but I need to ask you, because both
23 of you are here. It says in the first paragraph that,
24 "PFS has decided to wait until after it obtains a
25 license to conduct most of the testing and analysis."

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1 Is that an answer that you provided?

2 DR. MITCHELL: I can't, at this point,
3 recall whether that was generated individually,
4 collectively, or after some discussion, to be honest
5 with you.

6 MR. TRAVIESO-DIAZ: But let me ask you the
7 specific question, do you have any information that
8 leads you to believe that PFS has made a conscious
9 decision that they're going to await the licensing
10 before they proceed with the program?

11 DR. MITCHELL: It's my understanding that
12 that is their intention. They talk in the SAR about
13 completing this during the final design phase, but I
14 must admit that it was difficult for me in reading it
15 to know exactly when that final design phase is to
16 begin and end.

17 MR. TRAVIESO-DIAZ: Okay. Maybe the --
18 perhaps we're talking about two different things.
19 What you're refer -- is it your testimony that what
20 you're referring here in answer 8 is the construction
21 phase? The question refers to tests.

22 DR. MITCHELL: Right. It says that, "If
23 PFS intends to wait until after it obtains the license
24 to conduct most of the testing and analysis."

25 MR. TRAVIESO-DIAZ: Okay. And my question

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1 to you was I understand that the SAR says that the
2 construction will take place, of course, after the
3 licensing.

4 DR. MITCHELL: Certainly.

5 MR. TRAVIESO-DIAZ: The question I have
6 for you is, do you read in the SAR an intent on the
7 part of PFS not to complete testing until after it
8 gets the licensing?

9 DR. MITCHELL: That is my understanding.

10 MR. TRAVIESO-DIAZ: Okay. And your
11 understanding on that is based on your reading the
12 SAR.

13 DR. MITCHELL: I think reading the SAR and
14 the discussions that have gone on.

15 MR. TRAVIESO-DIAZ: So you're not aware of
16 the testimony that has been given by Mr. Trudeau that
17 that's not their intent. It may happen in terms of
18 timing, that the test may still be ongoing when the
19 licensing decision is made, but they haven't made the
20 conscious decision to postpone doing any more testing
21 until after the licensing.

22 DR. MITCHELL: I -- you know, I don't know
23 about that. I know that there's discussion of the
24 testing programs, and who might do them and when, but
25 as near as I can tell from the testimony that has been

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1 given, no final decisions have been made on that.

2 MR. TRAVIESO-DIAZ: Okay. Let's move to
3 the second paragraph of answer 8. The second
4 paragraph starts by saying, "There are only two
5 documents that described PFS' Soil Cement Program, the
6 SAR section that we discussed previously, and the
7 ESSOW that we just also discussed a moment ago."

8 DR. MITCHELL: Yes.

9 MR. TRAVIESO-DIAZ: Do you see that? Now
10 in light of your testimony, that the ESSOW is a good
11 guideline, and the SAR presents the program that PFS
12 intends to present, is there anything else that's
13 needed?

14 DR. MITCHELL: In what way?

15 MR. TRAVIESO-DIAZ: Well, it says --
16 perhaps it's the wording of this phrase that I'm sort
17 of trying to understand. It says, "Only two
18 documents." To me, only implies that you wish there
19 were more, or that there's things that are missing.
20 Maybe I'm misreading your testimony. What do you mean
21 "only"?

22 DR. MITCHELL: Well, I guess in reading
23 it, it would be fair to say there are two documents
24 that describe. I don't think the word "only" at this
25 point is essential.

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1 MR. TRAVIESO-DIAZ: And you mean that
2 those are sufficient for the reasons that you
3 described earlier?

4 DR. MITCHELL: I think they describe the
5 proposed testing program, and the basis for the design
6 and construction, and that seems to say what needs to
7 be said.

8 MR. TRAVIESO-DIAZ: Thank you. Let me
9 take a look -- let me have you take a look at the last
10 sentence of answer 8. It says, "Also, if in the
11 future PFS finds that soil cement and cement-treated
12 soil will not support PFS' seismic design, then the
13 licensing basis for approving the PFS facility design
14 will be invalid." Did I read that right?

15 DR. MITCHELL: You read what is written,
16 yes.

17 MR. TRAVIESO-DIAZ: Well, what do you mean
18 by "invalid"?

19 DR. MITCHELL: I believe there what we are
20 saying is that if a licensing approval has been made
21 based on the assumptions and the conditions that are
22 thought to be possible at this stage, then if in the
23 future you can't get what has been hoped for, that the
24 original decision would not have been a valid one.

25 MR. TRAVIESO-DIAZ: Or would have become

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1 invalidated?

2 DR. MITCHELL: Yes, would become
3 invalidated. The words get tangled up here.

4 MR. TRAVIESO-DIAZ: I understand. And do
5 you mean by "invalidated", that PFS will not be able
6 then to utilize its license to construct the facility
7 and store the soil cement?

8 MS. CHANCELLOR: Objection. Calls for a
9 legal conclusion.

10 MR. TRAVIESO-DIAZ: I'm just trying to
11 probe what the witness thinks is going to happen in
12 his words.

13 CHAIRMAN FARRAR: Overruled. You may
14 answer.

15 DR. MITCHELL: I don't know what the
16 consequences would be within the framework of the
17 regulations, because I'm not at all familiar with the
18 intricacies of NRC licensing and regulatory
19 procedures.

20 MR. TRAVIESO-DIAZ: Well, suppose that --
21 well, let's not suppose. Using your statement a
22 moment ago that the license that was issued somehow
23 would have become invalidated, why should we care?
24 Why should anybody but PFS care about that?

25 DR. MITCHELL: Well, maybe you don't, but

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1 it would seem to me that if I were somebody involved
2 in the NRC, having given approval to something on a
3 certain presumed basis, and then I find that that
4 basis is not there, I think I'd have some concerns.
5 And I would hope that there were some way that you
6 could then say to the applicant look, you're not
7 delivering what you said you would. You've got to go
8 back and make some corrections, and let us look at it
9 again.

10 MR. TRAVIESO-DIAZ: And that's what you
11 hope or expect will happen?

12 DR. MITCHELL: I wouldn't -- well, that's
13 perhaps somewhat of a loaded question. I don't hope
14 that that would happen, because I -- you know, I just
15 don't think that would be a good outcome, but it could
16 happen. And if it did, there has to be means in place
17 to take care of it.

18 MR. TRAVIESO-DIAZ: You were talking a
19 moment ago about economic consequences. Isn't it a
20 fact that if PFS got into the type of difficulty
21 you're talking about, all it would mean is a financial
22 penalty to PFS, as to having to do things over,
23 satisfy the NRC somehow?

24 DR. MITCHELL: Well, it's a financial
25 penalty. It's a time cost, and it doesn't affect,

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1 necessarily, just PFS. It affects a lot of other
2 people. I mean, you only need to cite Enron as an
3 example of what can happen when some big organization
4 flounders and goes under.. A lot of small people get
5 hurt.

6 MR. TRAVIESO-DIAZ: Let's -- staying with
7 -- well, let's move to page 8 for your testimony,
8 answer 23. If I understand that answer, you are
9 talking about the various mechanisms through which
10 cracks may form in soil cement. Is that right?

11 DR. MITCHELL: Yes.

12 MR. TRAVIESO-DIAZ: Okay. Before we talk
13 about these various mechanisms, let's talk about the
14 cracks themselves. If you go back again to your
15 deposition transcript, and go to page 133, we talk
16 about cracks at some length for two pages. In fact,
17 from 133 to 135, and this is what I remember you said.
18 Now you may want to refer back in case you think it
19 isn't right. But if I remember, you said that you
20 expected that the cracks that developed would be in
21 the soil cement and in the cement-treated soil would
22 be thin. Is that correct?

23 DR. MITCHELL: Excuse me. The cement-
24 treated soil would be what?

25 MR. TRAVIESO-DIAZ: That cracks that could

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1 develop through these mechanisms in the cement-treated
2 soil, and in the soil cement would be thin cracks?

3 DR. MITCHELL: Probably would be thin.

4 MR. TRAVIESO-DIAZ: Yes.

5 DR. MITCHELL: Narrow cracks.

6 MR. TRAVIESO-DIAZ: Okay. And it would be
7 vertical?

8 DR. MITCHELL: Probably close to vertical.

9 MR. TRAVIESO-DIAZ: What do you mean
10 close, you mean just at most a few degrees?

11 DR. MITCHELL: Maybe, I don't know, up to
12 10 or 20 degrees off of vertical. I don't know for
13 sure.

14 MR. TRAVIESO-DIAZ: Okay.

15 DR. BARTLETT: We're talking about static
16 cracks due to environmental effects, not seismic
17 effects.

18 MR. TRAVIESO-DIAZ: That's correct.

19 DR. BARTLETT: Okay.

20 MR. TRAVIESO-DIAZ: If I understand the
21 testimony here that you both gave, is in answer 23,
22 you're not talking about --

23 DR. BARTLETT: These are environmental
24 conditions.

25 MR. TRAVIESO-DIAZ: That's what I

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1 understand your testimony.

2 DR. BARTLETT: That's fine.

3 MR. TRAVIESO-DIAZ: Is that correct? This
4 is what you're talking about.

5 DR. BARTLETT: I'm just making sure that
6 I'm clear that that's what Dr. Mitchell is discussing,
7 that we're all discussing.

8 MR. TRAVIESO-DIAZ: I think that we're on
9 the same page, but if you have reason to think
10 otherwise, let's get it correct. Talking about these
11 five mechanisms, it does seem to me that they are
12 environmental mechanisms. Is that right?

13 DR. MITCHELL: Not number five.

14 MR. TRAVIESO-DIAZ: Cracking over
15 stressing due to vehicle loads is not --

16 DR. MITCHELL: That's not environmental in
17 the same sense.

18 MR. TRAVIESO-DIAZ: Okay. But let's say
19 as opposed to dynamic loads, I mean dynamic earthquake
20 loads.

21 DR. MITCHELL: That's true. In this case,
22 we're talking about dynamic vehicle loads.

23 MR. TRAVIESO-DIAZ: All right.

24 DR. MITCHELL: And static vehicle loads,
25 if they park.

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1 MR. TRAVIESO-DIAZ: All right. Now given
2 that these soil cement layers that we're talking about
3 here, both the cement-treated soil and the soil
4 cement, are several feet thick, would it be your
5 expectation that any of these cracks will run through
6 the entire from one -- from the top to the bottom of
7 any of these layers?

8 DR. MITCHELL: It's perhaps not likely.
9 You know, I have no specific precedent to cite average
10 crack depths, and widths, and continuities, but we're
11 looking at a layer that's -- well, there's two feet of
12 cement-treated soil, and then 2.8 feet of cement-
13 treated base, soil cement.

14 DR. BARTLETT: I believe the design PFS
15 has put forward is the cement-treated soil ranges
16 between one foot minimum and two foot maximum.

17 DR. MITCHELL: Right.

18 DR. BARTLETT: And the soil cement, I
19 believe, is 2.4 inches, and it's overlain by eight
20 inches of gravel.

21 MR. TRAVIESO-DIAZ: And for the building
22 is how deep, how thick?

23 DR. BARTLETT: I believe it -- the soil
24 cement, I believe, is approximately five feet.

25 MR. TRAVIESO-DIAZ: Five feet.

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1 DR. MITCHELL: Five feet, yes.

2 MR. TRAVIESO-DIAZ: But with these
3 dimensions in mind -- I'm sorry. Could you repeat the
4 answer you began giving?

5 DR. MITCHELL: It could be unlikely that
6 you would have one continuous crack going all the way
7 through. I'm not sure that there's a lot of
8 information to draw on there from actual cases where
9 you have soil cement layers that are that thick, as to
10 how deep they go.

11 MR. TRAVIESO-DIAZ: Let's run through the
12 various crack formation mechanisms. Let's look at
13 answer 24, first. That starts on page 8, and goes
14 onto page 9. And because we're talking about various
15 soil cement and cement-treated soil materials, we may
16 need to make differences, if there are any, among the
17 various types. And feel free to keep that in mind as
18 I ask you the questions, if I miss making the
19 distinction myself.

20 If I understand the testimony at answer
21 24, the potential crack formation mechanism that is of
22 most concern are the shrinkage and curing cracks that
23 form during the process of actually constructing soil
24 cement and cement-treated soil. Is that right?

25 DR. MITCHELL: They are the ones that are

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1 most likely to form. They seem to be inevitable.
2 There is a whole section in the ACI Soil Cement state-
3 of-the-art that we were discussing yesterday about
4 shrinkage cracks. They may or may not be deleterious,
5 depending on how wide they are, and how far apart
6 they're spaced. Perhaps the most damaging cracks
7 could be those that would be caused by excessive
8 bending stresses at the bottom of the treated soil.

9 MR. TRAVIESO-DIAZ: Okay. Now let's first
10 try to concentrate on what you mean by "of most
11 concern". Are you saying that of most concern, that
12 you're using that term because you think that it's
13 most likely to happen?

14 DR. MITCHELL: No, I'm using the term
15 because if it does happen, it might have the greatest
16 impact on the integrity of the soil cement.

17 MR. TRAVIESO-DIAZ: And why is that?

18 DR. BARTLETT: The tensile capacity.

19 DR. MITCHELL: Yeah, this is exceeding the
20 tensile capacity, and it's going to take away the
21 structural, some of the structural competence of the
22 layer.

23 MR. TRAVIESO-DIAZ: We may get into this
24 a little bit more later, but is it your understanding
25 that PFS relies on, or draws on the tensile strength

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1 of the cement-treated soil for providing the design
2 basis support that soil cement or function that the
3 cement soil intends to give?

4 DR. BARTLETT: It's my understanding that
5 PFS in their design calculations put forth the
6 proposition that the only properties required for the
7 soil cement and cement-treated soil are compressor
8 strength, and shear strength. The State has, for
9 quite some time, disputed that fact, we believe
10 because of the cyclic nature of the earthquakes, that
11 tensile forces will also be induced in the soil
12 cement, and the cement-treated soil. These tensile
13 forces and their stresses are important because it's
14 only the tensile cap -- the tensile capacity is
15 required to prevent out of phase motion between the
16 pads and adjacent pads, and the soil cement. And
17 likewise, out of phase motion between the canister
18 transfer building and the soil cement. And the fact
19 that these tensile cracks occur, and the tensile
20 capacity is low cannot -- this system cannot act as an
21 integrated mat. There will be out of phase motions,
22 and these will introduce pad-to-pad interaction, and
23 also canister transfer to soil cement interaction. We
24 discussed this quite at length.

25 MR. TRAVIESO-DIAZ: Yes. Though I'm

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1 sorely tempted to pursue like five or six things that
2 you said, I'm going to forebear, but my question to
3 both -- to you first, Dr. Bartlett. Both of you
4 actually is this, is it a fact -- isn't it a fact that
5 PFS based its design calculation for the pads, the
6 stability analysis relies on the sheer strength that
7 is provided by the bond between the soil cement and
8 the underlying layer, and that sheer strength is not
9 affected by tensile stresses?

10 DR. BARTLETT: PFS has a philosophy that
11 the load path for the horizontal earthquake motion is
12 transferred directly downward to the Bonneville Clay
13 via this cement-treated soil that acts as a coupling
14 mechanism. We have put forth the position, and
15 discussed quite at length that we do not agree with
16 that load path, that there are other load paths going
17 on and there's horizontal transfer of loads from pad
18 to pad, and the tensile capacity is important in this
19 load path.

20 MR. TRAVIESO-DIAZ: Dr. Mitchell, let me
21 ask you. I don't know how much you have gotten into
22 this particular part of the argument since it's not
23 directly the area that you're concerned about. But
24 isn't it a fact that if you have a bond of the type
25 that PFS intends to provide between your cement-

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1 treated soil and the pad, and the soil underneath,
2 that in the event of an earthquake, that -- those
3 bonds that are established in the soil cement and the
4 adjoining surfaces would provide sheer strength that
5 will be -- that will tend to resist the horizontal
6 motion -- horizontal forces that the earthquake would
7 produce?

8 DR. MITCHELL: I would expect that the
9 bond would help resist the sheers. The sheers will
10 vary with depth from top down, or bottom up, depending
11 on how you wish to look at it, which means there's
12 going to be differential movements laterally and
13 vertically within the system, and the net effect of
14 having cracks or failure by tensile stresses there may
15 or may not be significant. I simply don't know, but
16 I can visualize larger displacements if you have
17 cracks that are open. I can visualize sections that
18 are banging into each other and causing some crushing.
19 But again, I can't, because I've seen no analyses, nor
20 am I an expert in doing such an analyses, to indicate
21 whether that would be a factor or not.

22 MR. TRAVIESO-DIAZ: Thank you. As I said,
23 I'm going to forebear, Dr. Bartlett, if you'll pardon
24 me. We have gone over this already, so we'll save it
25 for another day.

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1 JUDGE LAM: May I ask you, gentlemen, why
2 was there no analysis performed by you?

3 DR. BARTLETT: Dr. Lam, in our case, it's
4 just simply that we don't have the resources to
5 perform those. These analyses are quite complex, and
6 the State of Utah, you know, didn't allow us to do
7 these type of analyses. Well, I shouldn't say didn't
8 allow us. It's just -- it was a judgment made by the
9 team that we could not, you know, really pursue these
10 type of analyses.

11 JUDGE LAM: So it was due to lack of
12 resources.

13 DR. BARTLETT: I think somewhat, yeah.

14 MR. TRAVIESO-DIAZ: And just so, again not
15 to reopen old wounds, isn't it a fact that PFS did
16 perform those analysis and Holtec presented them at
17 the last series of meetings we have in Salt Lake City?

18 DR. BARTLETT: Yes, those were presented,
19 and I think that the Holtec analysis showed that when
20 there was tensile capacity in the model, that the --
21 it calculated both the tensile forces and the
22 compressional forces in the springs. Those were shown
23 to be relatively large. I do recall also that when
24 the tensile capacity was left out of the springs, that
25 the compressional forces increased quite considerably.

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1 MR. TRAVIESO-DIAZ: Now, Dr. Mitchell, let
2 me go back to where we were. If you take a look at
3 your -- again, your deposition transcript, and we had
4 a discussion of shrinkage cracks that went for several
5 pages of the transcript, from 127 to 133. But I'm
6 going to ask you only to turn to page 131. Starting
7 on top of page 131, if I remember, you made a
8 distinction between the cracks that form in the
9 cement-treated soil through this process of curing and
10 shrinkage, and the cracks that may form in the other
11 soil cement. Do you remember that?

12 DR. MITCHELL: Yes, sir.

13 MR. TRAVIESO-DIAZ: Thank you. We need a
14 yes for the reporter.

15 DR. MITCHELL: Yes.

16 MR. TRAVIESO-DIAZ: You indicated then
17 that you didn't expect much in the way of cracks due
18 to this mechanism for the cement-treated soil because
19 there's not that much cement in the mix. Is that
20 right?

21 DR. MITCHELL: Yes. There were two
22 reasons.

23 MR. TRAVIESO-DIAZ: Okay. Please explain.

24 DR. MITCHELL: The other was because of
25 the protection by the slab above.

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1 MR. TRAVIESO-DIAZ: Tell me more on the
2 second one so that we can save time.

3 DR. MITCHELL: There's a -- it's a three
4 foot reinforced concrete mat over the top of the
5 cement-treated soil. And that prevents direct
6 exposure of the treated soil to the atmosphere.

7 MR. TRAVIESO-DIAZ: So would it be fair to
8 say that you expect, if shrinkage and curing cracks
9 are going to be a problem, they are going to be more
10 of a problem for the soil cement that is around the
11 pads, and around the canister transfer building?

12 DR. MITCHELL: That was my feeling then.
13 Now let me say I'm not so sure.

14 MR. TRAVIESO-DIAZ: Okay. Tell us --

15 DR. MITCHELL: And that is because you
16 have now presented us with, somebody presented us with
17 these thermal studies, which I have not had a chance
18 to read yet, but I have learned more about the higher
19 temperatures that are going to be beneath the casks,
20 which are going to have some impact on the cement-
21 treated soil.

22 MR. TRAVIESO-DIAZ: What sort of an
23 impact?

24 DR. MITCHELL: As you've, I believe,
25 indicated yesterday, it's going to drive the moisture

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1 down and away. We're dealing with soils that have
2 some plasticity, and when they dry, they tend to
3 shrink. And when soils tend to dry and shrink, they
4 tend to crack.

5 MR. TRAVIESO-DIAZ: So there may be more
6 cracking, perhaps, because they're going to be drier
7 than you expected them to be.

8 DR. MITCHELL: That seems to be a
9 possibility.

10 MR. TRAVIESO-DIAZ: By the same token, the
11 drier they are, the stronger they get. Is that right?

12 DR. MITCHELL: Not if they're cracked.

13 MR. TRAVIESO-DIAZ: Well, assuming for the
14 moment that you're only talking about horizontal
15 forces and, in other words, compression or sheer
16 forces, as opposed to bending forces.

17 DR. MITCHELL: If the direction of the
18 cracks is not a critical one in terms of influencing
19 the compressive or sliding resistance, or sheer
20 resistance, yes, you're right.

21 MR. TRAVIESO-DIAZ: And would you expect
22 the cracks to be anything other than vertical, even in
23 this situation?

24 DR. MITCHELL: I don't know now. This is
25 a new problem.

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1 MR. TRAVIESO-DIAZ: Okay. Now isn't it
2 true that shrinkage and curing cracks, if they occur,
3 are evidenced once the curing process is complete?

4 DR. MITCHELL: I don't quite understand
5 the question.

6 MR. TRAVIESO-DIAZ: Well, suppose that you
7 build a lift of cement-treated soil, and you allow it
8 to cure before you proceed to the next phase, isn't it
9 true that the curing cracks will be evidenced by the
10 time your curing is complete?

11 DR. MITCHELL: When is the curing
12 completed, perhaps, is another question that need be
13 asked, because these materials continue to cure
14 indefinitely. And the strength, the stiffness
15 continue to increase in properly designed and
16 constructed material for many, many years, and at what
17 stage the cracks are going to appear is not always
18 clear, I don't believe.

19 MR. TRAVIESO-DIAZ: Well, based on your
20 experience, would you expect that most of the cracks
21 that would appear due to curing would manifest
22 themselves in the early curing process?

23 DR. MITCHELL: I would say it's more
24 likely that they will appear within months rather than
25 years.

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1 MR. TRAVIESO-DIAZ: All right. And to the
2 extent that those cracks have manifested themselves,
3 say before the next lift is placed, you could grout
4 them at that point, couldn't you?

5 DR. MITCHELL: Oh, you could, but it was
6 not my understanding that you would wait that long
7 between placement of successive lifts.

8 MR. TRAVIESO-DIAZ: But to the extent that
9 cracks are in evidence before you place the next lift,
10 you will have the opportunity to grout them if you so
11 desire. Right?

12 DR. MITCHELL: I think you would. That
13 would be a very unconventional type of construction,
14 I think, for soil cement structure.

15 MR. TRAVIESO-DIAZ: Okay. Now if I
16 remember your testimony, you indicated there are a
17 number of things that can be done to minimize the
18 potential for the formation of shrinkage and curing
19 cracks.

20 DR. MITCHELL: Can you direct me
21 specifically to --

22 MR. TRAVIESO-DIAZ: Oh, you had to ask
23 that.

24 DR. MITCHELL: Yeah.

25 MR. TRAVIESO-DIAZ: That's the one that I

1 didn't look for. It's somewhere in that area, but put
2 your deposition transcript aside for a second. Tell
3 me based on your experience, isn't it true that there
4 are things that you can do to minimize the potential
5 for formation of shrinking and curing cracks?

6 DR. MITCHELL: Perhaps the most important
7 thing to do is to prevent the material from drying,
8 and that --

9 MR. TRAVIESO-DIAZ: I'm sorry. Please go
10 ahead.

11 DR. MITCHELL: And you could do that by
12 sealing.

13 MR. TRAVIESO-DIAZ: I'm sorry. Say that
14 again.

15 DR. MITCHELL: By sealing the surface.

16 MR. TRAVIESO-DIAZ: Okay. Sealing by
17 putting like a plastic cover or something similar to
18 it?

19 DR. MITCHELL: You could do a plastic
20 cover, a bituminous spray. There are several options,
21 I think, there.

22 MR. TRAVIESO-DIAZ: I am uncertain at this
23 point, but I -- my memory, which is not very good,
24 reminds me that Dr. Wissa mentioned that that was --
25 that was one of the options that PFS was considering

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1 using for preventing this type of cracking. Isn't
2 that right?

3 DR. MITCHELL: Yes.

4 MR. TRAVIESO-DIAZ: Okay. In fact, I
5 should have looked at the transcript. You discussed
6 these things in pages 128 to 130, but I think you have
7 given us an idea. You may want to refresh your memory
8 as to what you said there.

9 DR. MITCHELL: Right. This is where one of
10 the errors in the transcript appears, on line 12 of
11 page 130.

12 MR. TRAVIESO-DIAZ: Okay.

13 DR. MITCHELL: "A seal coat, a pitumitous
14 material." I don't know what that is.

15 MR. TRAVIESO-DIAZ: I think everyone
16 understood that to be bituminous.

17 DR. MITCHELL: It should be bituminous.

18 MR. TRAVIESO-DIAZ: All right. But in the
19 interest of saving time, the other mechanisms that
20 could be used are methods to minimize the potential
21 for shrinkage and curing cracks, are discussed in
22 these two pages, three pages. Is that correct?

23 DR. MITCHELL: Yes.

24 MR. TRAVIESO-DIAZ: Let's move on. In
25 answer 26 of your testimony, you indicate that another

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1 mechanism that could be used, that could lead to crack
2 formation is differential settlement around the
3 perimeter of canister transfer building and the pads,
4 and beneath the pads. And you quote a PFS estimate of
5 two inches of total settlement for the pads, and three
6 inches for the canister transfer building. Do you see
7 that?

8 DR. MITCHELL: Yes.

9 MR. TRAVIESO-DIAZ: Are you aware that
10 testimony was given at the hearings in Salt Lake City
11 based on an analysis by Mr. Trudeau, that we haven't
12 had time to talk about yet, that the maximum
13 settlement that was expected originally to occur on
14 the pads was in the order of half an inch?

15 DR. BARTLETT: I don't believe Dr.
16 Mitchell was present for that testimony.

17 MR. TRAVIESO-DIAZ: No. I'm asking if he
18 was aware.

19 DR. MITCHELL: I am not. I have not been
20 informed of that testimony.

21 DR. BARTLETT: That is an issue in
22 rebuttal that I think we'll address.

23 MR. TRAVIESO-DIAZ: Well, let me ask Dr.
24 Mitchell a hypothetical.

25 Dr. Mitchell, assuming that, in fact, it

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1 was established that it was reasonable to expect that
2 there would be no more than half an inch settlement
3 between the pads and the soil cement; would that
4 create in your mind still a concern about crack
5 formations through this mechanism?

6 DR. MITCHELL: This half inch differential
7 is between where and where; the center of the pad and
8 the soil cement, or at the edge?

9 MR. TRAVIESO-DIAZ: I'm sorry, I am
10 corrected by people who know more than I do. The
11 testimony will be that half inch is the maximum total
12 sediment.

13 And assume, for this hypothetical, that
14 the maximum total settlement will be towards the
15 center of the pad, as opposed to in the edges. What
16 would that do to your concern of a potential, under
17 that hypothetical condition, what would that do to
18 your concern about potential settlement, crack
19 formation due to this mechanism?

20 DR. MITCHELL: If, indeed, the settlement
21 were only a maximum of one half inch differential
22 between the center of the pad, and the soil cement, it
23 would alleviate my concern a great deal.

24 MR. TRAVIESO-DIAZ: Thank you. And with
25 the, again, this is your understanding that there is

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1 three inches that are quoted for the canister transfer
2 building are a maximum figure, maximum settlement?

3 DR. MITCHELL: I can't answer the
4 question, I have not studied the settlement
5 calculations for the transfer building.

6 MR. TRAVIESO-DIAZ: All right. And, again,
7 based on your knowledge of how weights of structures
8 are distributed, would you expect, again, that for the
9 canister transfer building the maximum settlement will
10 be in the center, where the center of most of the
11 building is, as opposed to the perimeter?

12 DR. BARTLETT: It also depends on the
13 flexibility and rigidity of the mat.

14 MR. TRAVIESO-DIAZ: Let me see what Dr.
15 Mitchell has to say.

16 DR. MITCHELL: That is what I was mulling
17 over, was trying to think of my distributions for the
18 stresses, and having to take into account the
19 stiffness of the mat, and the stiffness of the
20 underlying soils, and the extent to which they behave
21 as frictional materials and cohesive materials.

22 And I cannot say, with any certainty, what
23 that settlement pattern would be, I'd need to see the
24 analyses that were done.

25 MR. TRAVIESO-DIAZ: But my question was

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1 not, was concentrated, if you will, on the static
2 settlement that would occur over time, which is, I
3 believe, what we are talking about here.

4 The settlement that will occur due to the
5 weight of the building, not due to dynamic forces, or
6 whatever.

7 DR. BARTLETT: Again, I think it is
8 difficult to calculate those settlements, because
9 there is the flexibility of the matter, the rigidity
10 of the mat has to be considered, the depth to the
11 compressible layer, and other factors.

12 So it is hard just to offer an opinion
13 shooting from the hip.

14 MR. TRAVIESO-DIAZ: Dr. Bartlett, thank
15 you, but I was asking Dr. Mitchell first.

16 DR. MITCHELL: Well, he has given a good
17 answer, I think.

18 MR. TRAVIESO-DIAZ: Well, in that case --

19 DR. MITCHELL: I would add to that, that
20 we need to know, since these casks are very heavy, how
21 are they distributed within the building, and how long
22 are they there, and all these kinds of things.

23 So it is not a question that I can give a
24 ready answer to.

25 MR. TRAVIESO-DIAZ: All right. So you

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1 don't have an answer for that.

2 Go back to your answer number 23. You
3 talk there about another mechanism being, and actually
4 that is the first one that is listed, delamination or
5 debonding along the soil cement lift interface, or the
6 interfaces with the soil, or the concrete pad.

7 Do you see that?

8 DR. MITCHELL: I do.

9 MR. TRAVIESO-DIAZ: Okay. I don't
10 remember that that was brought up in the deposition.
11 Is this a concern of yours, or Dr. Bartlett's, or
12 both?

13 DR. MITCHELL: I think that is one that we
14 sort of talked about together, if I remember
15 correctly.

16 MR. TRAVIESO-DIAZ: But this was since
17 your deposition?

18 DR. MITCHELL: I think we talked about it
19 at the time we prepared the testimony, and whether we
20 talked much about it before or not, I just don't
21 remember.

22 MR. TRAVIESO-DIAZ: My only reason I'm
23 asking is because I don't remember that we discussed
24 that during the deposition. So I was wondering
25 whether this was something that occurred to you

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1 afterwards, or how it came to your mind.

2 But let's get into the more important
3 thing. You were here yesterday when both Mr. Trudeau
4 and Dr. Wissa talked about the steps that PFS intends
5 to take, to take to make sure that there is
6 appropriate bonding between all the surfaces?

7 DR. MITCHELL: Yes.

8 MR. TRAVIESO-DIAZ: Do you remember we
9 were talk about the mustard and the ham?

10 DR. MITCHELL: That is right, yes.

11 MR. TRAVIESO-DIAZ: And did that
12 discussion of what they intend to use, that this value
13 that they have a correct approach to dealing with this
14 potential problem?

15 DR. MITCHELL: Yes.

16 MR. TRAVIESO-DIAZ: Thank you. Now you
17 talk, also, in answer 23 about frost penetration and
18 expansion cracking. Do you see that?

19 DR. MITCHELL: Yes.

20 MR. TRAVIESO-DIAZ: Again, we talked about
21 that at your deposition. If you turn to pages 141 and
22 142, to refresh your memory you said then that you
23 didn't think this would be much of a problem because
24 there was really no way for moisture to get down into
25 the soil cement layers through the reinforced concrete

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1 three foot -- I'm sorry, cement treated soil layers
2 through the concrete pads. Is that correct?

3 DR. MITCHELL: I did say that, yes.

4 MR. TRAVIESO-DIAZ: Is that still your
5 view?

6 DR. MITCHELL: I've had some second
7 thoughts about that.

8 MR. TRAVIESO-DIAZ: Tell me how you are
9 going to get water through a three foot thick concrete
10 pad into cement treated soil below?

11 DR. MITCHELL: You are not, unless the pad
12 is cracked.

13 MR. TRAVIESO-DIAZ: And how would the pad
14 crack?

15 DR. MITCHELL: I don't know, if it were
16 overloaded of course it could crack. Sometimes
17 concrete slabs crack, witness my garage floor, for
18 reasons that we don't understand, perhaps.

19 But I do, and I don't know if this is the
20 appropriate time to bring it up, I do have another
21 concern that has come up with regard to this idea of
22 moisture getting into the cement treated soil, and
23 into the soil cement.

24 MR. TRAVIESO-DIAZ: Well, let's
25 concentrate, for the moment, on how you expect that

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1 the three foot thick reinforced concrete pad will
2 crack.

3 Tell me how you think that could happen?

4 DR. MITCHELL: One is we were sent a
5 calculation sometime over the weekend, and I want to
6 find it. There was a figure that goes back to this
7 two percent strain in the Bonneville clay, beneath the
8 soil cement, and the vertical deformations.

9 And there was a calculation with some
10 figures that showed the deflections of three points,
11 and a finite element mesh at the elevation of the top
12 of the Bonneville clay. And I think those deflections
13 went up to something of the order of 1.7 inches under
14 a cask drop or tip over, in that analysis.

15 MR. TRAVIESO-DIAZ: So your concern is
16 that in the event there was, through some mechanism
17 that has not been defined, or assumed, a cask were to
18 tip over, it might crack the soil, the reinforced
19 concrete pad?

20 DR. MITCHELL: If there is a vertical
21 deformation of 1.7 inches at the top of the Bonneville
22 clay, and the cement treated soil and that concrete
23 slab are expected to follow along behind, that is
24 going to put a very, very large, I believe, and I
25 haven't seen the calculations that have been made, but

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1 it could put a very large tensile stress in the bottom
2 of that concrete mat.

3 MR. TRAVIESO-DIAZ: I understand.

4 DR. MITCHELL: Which could cause cracking.

5 MR. TRAVIESO-DIAZ: I'm sorry, but my
6 question to you was, was that your understanding, that
7 that calculation assumed in order for that strain to
8 take place, to have a cask drop on the concrete mat?

9 DR. MITCHELL: Yes, that is what the
10 calculation was for.

11 MR. TRAVIESO-DIAZ: Okay. So the concrete
12 mat would only crack, or would crack under that
13 scenario, if you have a cask drop on it?

14 DR. MITCHELL: I can't say whether it
15 would, or it wouldn't, because I have not seen any
16 analysis of it. But it seems to me that with
17 deformations of that magnitude there could be a good
18 possibility.

19 MR. TRAVIESO-DIAZ: But then the concern
20 about water infiltrating into the cement treated soil
21 beneath the pad would be something that would occur
22 subsequent to having a cask drop on the pad, is that
23 it?

24 DR. MITCHELL: By that mechanism, yes.

25 MR. TRAVIESO-DIAZ: Yes, okay. Now, what,

1 first of all, what do you think, how do you think that
2 a situation in which a cask dropped on the pad would
3 occur?

4 DR. MITCHELL: If I remember correctly,
5 there was a tip-over analysis, and this was a drop
6 analysis of some number of inches. And I guess that
7 would have to be ascribed to the thing getting away as
8 the transporter is trying to put the cask in place, or
9 during a movement operation.

10 MR. TRAVIESO-DIAZ: All right. Let's
11 assume that for the moment.

12 DR. BARTLETT: It might also be due to a
13 seismic event.

14 MR. TRAVIESO-DIAZ: Okay, well, let's take
15 that too. If we -- let's take them in order.

16 MS. CHANCELLOR: Could I just interject
17 for a moment? Does Dr. Mitchell need a copy of the
18 calculation that you are trying to find amongst your
19 things?

20 MR. TRAVIESO-DIAZ: Please feel free to
21 give it to him, but I think my questions are not going
22 to require looking at it.

23 DR. MITCHELL: No, if we are agreed that
24 there is one that shows in this finite element
25 analysis, of these three nodes, that the deformations

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1 go up to, I think, it is 1.7 inches maximum, or
2 something like that.

3 MR. TRAVIESO-DIAZ: Let me ask you the two
4 questions. First, if a cask broke in a transport
5 situation, and causes a crack in the pad, would you
6 then expect that once the cask is uprighted that the
7 pad would be repaired?

8 DR. MITCHELL: Probably would be.

9 MR. TRAVIESO-DIAZ: Okay. And yours, Dr.
10 Bartlett, if you have a seismic event and the cask
11 drops, why do you care where water infiltrates through
12 the crack that is from the soil cement, and the cement
13 through the soil is whole cement?

14 DR. BARTLETT: I'm just saying that, I'm
15 just reminding that there is another mechanism. Let
16 me also add to Dr. Mitchell's testimony about
17 potential cracking of concrete.

18 My experience has been looking at bridge
19 decks in Utah, over time, we are not talking,
20 generally, about three foot concrete slabs, they are
21 more on the order of maybe a foot, they are heavily
22 reinforced concrete slabs.

23 Microcracking occurs in the concrete due
24 to curing. However, because we have such high sulfate
25 and salt contents in our soils, and also just present

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1 in Utah, that this microcracking allows for water to
2 infiltrate, and it attacks the rebar, causes the
3 rebar, essentially, to begin to rust.

4 Once that process starts the rebar
5 expands, the concrete spalls, and cracks. It is a
6 well-known phenomenon to us. Again, I haven't studied
7 three foot slabs, but it is quite prevalent in one
8 foot thick reinforced slabs in Utah.

9 MR. TRAVIESO-DIAZ: And in bridges, not in
10 pads sitting on the soil, is that right?

11 DR. BARTLETT: I don't know if I would
12 draw such an important distinction, whether it is
13 sitting on the soil, or suspended in the air. I think
14 the sulfate and sulfides, and salt attack would occur
15 whether it is in the air or sitting on the soil.

16 MR. TRAVIESO-DIAZ: Tell me how would the
17 sulfate get to the concrete pad? The pad is sitting
18 on top of soil cement, cement treated soil, how does
19 the sulfate get to it?

20 DR. BARTLETT: Have you ever seen a dust
21 storm in Utah? It carries salt.

22 MR. TRAVIESO-DIAZ: Salt from above, not
23 from below?

24 DR. BARTLETT: Salt gets there from many,
25 many cases. I wish we could get rid of this problem,

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1 frankly, it causes a lot of trouble. But the sulfides
2 and salts get there. Some of them may even be present
3 in the soil, some of them may be windblown.

4 MR. TRAVIESO-DIAZ: I would love to
5 discuss this with you, but I don't think we have time.

6 DR. BARTLETT: We will discuss it some
7 other time.

8 MR. TRAVIESO-DIAZ: But is it your
9 testimony that it is reasonable to expect that cracks
10 will develop throughout the three foot layer of
11 heavily reinforced concrete, that will allow water to
12 get into the soil cement below?

13 DR. BARTLETT: I'm extrapolating my
14 experience. Again, it is viewing one foot thick
15 slabs, and a three foot thick slab is, obviously, much
16 more massive. So I'm not sure that I can extrapolate
17 that.

18 I'm just telling you that there are
19 mechanisms that cause cracking and spalling of
20 concrete.

21 MR. TRAVIESO-DIAZ: My question to you
22 was, whether you thought it was reasonable to expect
23 that would occur?

24 DR. BARTLETT: I can't say whether it is
25 reasonable or not. I haven't looked at three foot

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1 thick pads.

2 MR. TRAVIESO-DIAZ: Dr. Mitchell, we left
3 you hanging here. You were saying that there was,
4 potentially, another mechanism that could cause
5 infiltration of water into the cement treated soil
6 beneath the concrete pad?

7 You said that this might not be the
8 appropriate time. Why don't you tell us, so we know?

9 DR. MITCHELL: If we recall the layout
10 now, which our pads that are 30 feet by 67 feet, and
11 three feet thick of reinforced concrete, separated by
12 30 feet, is that correct, 30 feet between the pads?

13 Thirty to thirty-five feet between the
14 pads, where you have upper 8 inches of compacted
15 aggregate material, then you have two feet four inches
16 of soil cement, and then you have one to two feet of
17 cement treated soil.

18 Now, we, I think, have agreed that there
19 is the likelihood of some shrinkage, cracking in the
20 soil cement. There is at least conceivably, the
21 possibility of some debonding, for whatever reason
22 laminar planes, and there is the normal hydraulic
23 conductivity of the compacted material.

24 We have this 30 foot wide aggregate filled
25 trench that is eight inches deep, that is most likely

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1 to fill up with water. Which, unless there are
2 adequate drainage provisions made, and there may or
3 may not be, I simply don't know, but we have each pad
4 surrounded by up to 8 inches of water in a shallow
5 bathtub.

6 What is going to happen to that water,
7 where is it going to go? Sure, a lot will evaporate,
8 obviously. But some may stand for a long time, and
9 provide a source of ingress into the cement treated
10 soils below.

11 MR. TRAVIESO-DIAZ: But what is underneath
12 that aggregate is two feet four inches of soil cement,
13 is that right?

14 DR. MITCHELL: Yes.

15 MR. TRAVIESO-DIAZ: How does it get to the
16 cement treated soil underneath the pad that is nowhere
17 near the aggregate?

18 DR. MITCHELL: There can be shrinkage
19 cracks in the soil cement, there most probably will be
20 shrinkage cracks within the soil cement.

21 MR. TRAVIESO-DIAZ: Are you aware that the
22 design that the PFS provides for natural runoff of all
23 waters around the pads towards the detention pond?

24 DR. MITCHELL: I'm not familiar with that
25 part of the design.

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1 MR. TRAVIESO-DIAZ: If such were a feature
2 of the design, would that alleviate your concern of
3 water accumulating in the bathtub that you described?

4 DR. MITCHELL: I don't know the details of
5 the design, but if it doesn't allow for a rapid
6 drainage of water from the aggregate, then I have a
7 concern.

8 If it does provide for rapid drainage of
9 water from the aggregate, then that problem doesn't
10 exist.

11 MR. TRAVIESO-DIAZ: All right. But
12 assuming, for the moment, that there is no provision,
13 so that we can take your concern and understand it
14 fully, your concern is that the water would filter
15 through the aggregate, go down into the soil cement
16 below, and find its way into the cement treated soil
17 adjacent to the soil cement, is that it?

18 DR. MITCHELL: It could.

19 MR. TRAVIESO-DIAZ: By the way, how much,
20 do you know what the annual precipitation is at Skull
21 Valley?

22 DR. BARTLETT: I do.

23 MR. TRAVIESO-DIAZ: All right.

24 DR. BARTLETT: It is about nine inches.

25 MR. TRAVIESO-DIAZ: Okay. With the total

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1 of nine inches of precipitation in the course of the
2 year, does that change your view of this potential
3 concern?

4 DR. BARTLETT: No, not really.

5 DR. MITCHELL: No, it doesn't change my
6 view. It means that the bathtubs would fill up less
7 frequently than they might in Florida, for example.
8 But I think the storms are likely to be high intensity
9 storms, a lot of water comes at once.

10 DR. BARTLETT: We can have high spring
11 runoffs.

12 MR. TRAVIESO-DIAZ: So you think that all
13 of those nine inches will come at once?

14 DR. BARTLETT: No, not necessarily. But
15 I'm just saying that during certain times of the year,
16 particularly in the spring, we can have high runoffs.

17 MR. TRAVIESO-DIAZ: All right. But you
18 never have more than nine inches altogether over the
19 course of the year, is that right?

20 DR. BARTLETT: Well, it is possible. I
21 mean, nine inches is the average, I don't know what
22 the standard deviations of the precipitation is.

23 MR. TRAVIESO-DIAZ: And, again, are you
24 familiar with the berm design at PFS? Perhaps you are
25 more familiar than Dr. Mitchell is.

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1 DR. BARTLETT: No, I'm not, really.

2 MR. TRAVIESO-DIAZ: Assuming that, in
3 fact, provisions have been made at PFS to convey
4 rainfall away from the area of the pads into a
5 detention pond, would this resolve your problem? Or
6 alleviate it?

7 DR. BARTLETT: Well, somewhat, but also
8 there is snowfall, and snow accumulation that can melt
9 quite rapidly, and that may not be diverted by the
10 berms, that would fall within the footprint of the pad
11 placement area, and may be melted quite quickly.

12 MR. TRAVIESO-DIAZ: And then you are
13 talking about whatever snow falls directly between --

14 DR. BARTLETT: Within the pad emplacement.
15 We are not talking about surface runoffs coming from
16 some other source.

17 MR. TRAVIESO-DIAZ: And is that included
18 in the nine inches?

19 DR. BARTLETT: What, the snowfall?

20 MR. TRAVIESO-DIAZ: Yes.

21 DR. BARTLETT: Yes. We include that, we
22 take credit for that.

23 MR. TRAVIESO-DIAZ: All right, okay.

24 DR. BARTLETT: We need that.

25 MR. TRAVIESO-DIAZ: So nine inches is both

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1 rainfall and snowfall?

2 DR. BARTLETT: It is total precipitation.

3 MR. TRAVIESO-DIAZ: As long as we are
4 talking about snow, let's talk about frost induced
5 cracks.

6 Dr. Mitchell, again, if I remember we
7 talked about this during your deposition. But isn't
8 it true that if your soil cement passed the durability
9 test, that it is very unlikely that you are going to
10 get freeze induced cracks?

11 DR. MITCHELL: It is unlikely, yes.

12 MR. TRAVIESO-DIAZ: All right. And you
13 are aware, of course, that PFS intends to perform
14 durability tests to ensure that a soil cement, the
15 soil cement meets those standards, the requirements,
16 is that right?

17 DR. MITCHELL: Yes, they've already tried.

18 MR. TRAVIESO-DIAZ: And they'll probably
19 try again, is that right?

20 Now, you said, in fact the last mechanism,
21 we had a little discussion as to whether this was
22 environmental, which is vehicle loads. Again, we
23 talked about that at your deposition.

24 And you indicated, there, that that was
25 something to watch for, but you had no real fear for

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1 whether this would be actually a problem, is that
2 correct?

3 DR. MITCHELL: I think that is basically
4 correct.

5 MR. TRAVIESO-DIAZ: So you catalogued it
6 as a potential problem, but you were not sure whether
7 this was even a real concern?

8 DR. MITCHELL: I would like to explain my
9 concern.

10 MR. TRAVIESO-DIAZ: Yes, please.

11 DR. MITCHELL: Since we are talking about
12 the same thing. And that is the cask transporter,
13 with the cask, is a pretty heavily loaded vehicle,
14 many tons as I recall.

15 And this thing travels between the pads on
16 the aggregate that is over the soil cement, that is
17 over the cement treated soil. We are looking at a
18 crushed stone layer over a soil cement pavement
19 structure, if you will, paved soil cement base.

20 And the cement treated soil sub-base, over
21 the Bonneville clay subgrade. In many ways like a
22 heavy duty highway, or airfield pavement. And I would
23 hope, I guess I would almost assume, that PFS has made
24 some studies of this vehicle loading, and its impact
25 on the stresses within this pavement structure, to

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1 demonstrate that the tensile capacity of these
2 structural elements, which now are the soil cement,
3 and the cement treated soil, has not been exceeded.

4 MR. TRAVIESO-DIAZ: You are not personally
5 aware whether PFS has conducted, in fact, such
6 studies?

7 DR. MITCHELL: I'm not aware of any.

8 MR. TRAVIESO-DIAZ: If those studies
9 existed, and they showed that the design takes into
10 account the loading that these vehicles will impart,
11 that would resolve your concern, is that correct?

12 DR. MITCHELL: It would, yes.

13 MR. TRAVIESO-DIAZ: Dr. Bartlett, are you
14 aware of whether those studies have been made by PFS?

15 DR. BARTLETT: I believe there is a
16 calculation for the canister transport vehicle.

17 MR. TRAVIESO-DIAZ: Have you reviewed it?

18 DR. BARTLETT: No, I haven't.

19 MR. TRAVIESO-DIAZ: So you don't have any
20 view as to --

21 DR. BARTLETT: No, not at this time. It
22 seems something that can be analyzed and calculated.

23 MR. TRAVIESO-DIAZ: Would both of you,
24 based on your experience, think that that is something
25 that any reasonably prudent engineer would think of,

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1 when you are dealing with vehicles of this size?

2 DR. BARTLETT: Yes.

3 DR. MITCHELL: I would certainly hope so.

4 MR. TRAVIESO-DIAZ: Okay, me too.

5 Mr. Chairman, I don't want to impose on
6 the Board, but this could be a good place for a break.

7 CHAIRMAN FARRAR: That is a good idea. It
8 is 10:25, we will be back at 10:40.

9 MS. CHANCELLOR: Could I ask Mr. Travieso-
10 Diaz how he is going as far as time?

11 CHAIRMAN FARRAR: Certainly.

12 MR. TRAVIESO-DIAZ: I can almost
13 confidently predict that I will be finished by
14 lunchtime.

15 CHAIRMAN FARRAR: All right, good.

16 MS. CHANCELLOR: Or before?

17 MR. TRAVIESO-DIAZ: Or before, if I talk
18 really fast we will.

19 CHAIRMAN FARRAR: We've tried that before.

20 MR. TRAVIESO-DIAZ: Yes, I know.

21 CHAIRMAN FARRAR: Let's, and as far as our
22 people are concerned, we can cancel all the
23 arrangements for Dr. Singh.

24 MR. TRAVIESO-DIAZ: Yes, I guess that
25 decision has been made.

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1 (Whereupon, the above-entitled matter
2 went off the record at 10:25 a.m. and
3 went back on the record at 10:42 a.m.)

4 CHAIRMAN FARRAR: We are back on the
5 record. Mr. Travieso-Diaz, you may continue.

6 MR. TRAVIESO-DIAZ: If I could take a
7 moment, I'm trying to see where I can reduce my
8 examination further.

9 CHAIRMAN FARRAR: All right.

10 MR. TRAVIESO-DIAZ: Mr. Chairman, let me
11 give it a try.

12 CHAIRMAN FARRAR: All right. Go ahead.

13 MR. TRAVIESO-DIAZ: Thank you.

14 CHAIRMAN FARRAR: Thank you.

15 MR. TRAVIESO-DIAZ: Dr. Mitchell, before
16 the break we were talking about how cracks may form.
17 Let's talk just briefly about what the consequences of
18 those crack formations are. I'm going to ask you not
19 from the dynamic analysis that Dr. Bartlett discussed
20 two weeks ago but from the other standpoints that you
21 are familiar with in terms of soil cement performance.

22 Let me ask first, we discussed there are
23 consequences of crack formation starting on page 140
24 of your deposition transcript. We had a very extended
25 discussion that went onto page 153. I'm not going to

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1 repeat any of that right here but if I could summarize
2 my understanding of what you said then.

3 Your testimony at that time was that the
4 main consequence from your perspective on the
5 formation of cracks is that they could lead to the
6 infiltration of moisture onto say the cement-treated
7 soil beneath the pads. Was that essentially the
8 consequence that you saw?

9 DR. MITCHELL: Yes. I talk about the
10 moisture and the potential degradation of things
11 caused by having the moisture there.

12 MR. TRAVIESO-DIAZ: The same concern was
13 water infiltration of potential degradation of the
14 soils under the canister transfer building.

15 DR. MITCHELL: Some of this pertains to
16 the material beneath the soil cement which is a zone
17 between the pads.

18 MR. TRAVIESO-DIAZ: In both cases, you are
19 concerned that a potential mechanism will be the
20 degradation of the qualities if you will of the native
21 soil that is underneath the cement-treated soil, for
22 the pads, and underneath the soil cement for the
23 canister transfer building.

24 DR. MITCHELL: If moisture got into the
25 Bonneville clay, it could weaken it somewhat I

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1 suppose. I would have the concern for the properties
2 of the cement-treated soil and the soil cement if
3 moisture got into it and beneath it.

4 MR. TRAVIESO-DIAZ: I'm sorry. I'm not
5 sure I understand you. Are you saying that you are
6 concerned about the properties of the soil cement
7 itself if moisture got into it?

8 DR. MITCHELL: There could be a weakening
9 particularly of the cement-treated soil if moisture
10 got into it near the bottom where I would expect any
11 tensile loading to be under the static loads and the
12 vehicle loads. If moisture got into the subgrade
13 soil, the Bonneville clay, you could have some
14 potential slight loss of strength.

15 MR. TRAVIESO-DIAZ: Okay. That's what I
16 was concerned about our understanding because in our
17 conversations in the past, I thought that you were
18 mostly concerned about the potential effect even if
19 it's slight on weakening of the native soil. I didn't
20 remember hearing you talk about potential degradation
21 with the soil cement itself. Could you explain that
22 to me because this is news to me?

23 DR. MITCHELL: Well, I note in my
24 deposition when I started talking about the
25 possibility and I would guess it would be slight in

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1 the areas where vehicles are passing by of a bumping
2 action if there's moisture down near the bottom of the
3 treated material just because of the deflections that
4 accompany the passage of the vehicles. If that
5 happens of course then you would have a weakening both
6 of the cement-treated material, the soil cement and
7 the soil below.

8 MR. TRAVIESO-DIAZ: Does that presume that
9 no adequate provisions have been made to provide
10 strengths to withstand those vehicle loads?

11 DR. MITCHELL: If the moisture got there
12 by infiltration through cracks, the fact that
13 provisions had been made to withstand vehicle loads
14 wouldn't be a factor. The moisture would be there.

15 MR. TRAVIESO-DIAZ: I'm sorry. I'm not
16 quite following you. You're saying that assuming the
17 moisture got through to the cement-treated soil
18 underneath the pads. I take it you are also assuming
19 that it would stay there. It wouldn't migrate down to
20 the soil below.

21 DR. MITCHELL: Well, I think my concern
22 here is more with the beneath the soil cement and
23 cement-treated soil between the pads then under the
24 pads.

25 MR. TRAVIESO-DIAZ: So the concern here is

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1 you're talking about the soil cement proper if you
2 will around the pads, not the cement-treated soil
3 underneath.

4 DR. MITCHELL: I think the cement-treated
5 soil underneath the pads based on what I know now
6 about the potential thermal effects and the like is
7 not likely to be affected too much by any moisture
8 getting in them.

9 MR. TRAVIESO-DIAZ: All right. So again,
10 do you know whether PFS takes credit in the design for
11 the strength of the soil cement picture frame, if I
12 can use that term, around the pads in any way?

13 DR. MITCHELL: I'm trying to remember
14 here. I believe they contend that they are not from
15 the standpoint of the seismic loading. Do I remember
16 correctly or not?

17 DR. BARTLETT: I do.

18 MR. TRAVIESO-DIAZ: All right. Dr.
19 Bartlett help us here.

20 DR. BARTLETT: The case that PFS puts
21 forward that the shear resistance provided to sliding
22 is only transferred downward through the cement-
23 treated soil to the Bonneville clay. In their design
24 calculations, there is no credit taken for "the
25 buttressing effect" with a passive resistance of the

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1 soil cement around the pads. However, we contend
2 since that the soil cement is there. You cannot
3 ignore it. It causes pad to pad interaction.

4 MR. TRAVIESO-DIAZ: All right. But that's
5 a different --

6 DR. BARTLETT: That's a different story.

7 MR. TRAVIESO-DIAZ: Thank you. And we
8 won't go there.

9 DR. BARTLETT: We won't go there.

10 MR. TRAVIESO-DIAZ: Let's talk for a
11 second about your concern, Dr. Mitchell, about a
12 potential weakening of the soils beneath this soil
13 cement around the pads and around the canister
14 transfer building. Your concern is that the
15 Bonneville clay that sits under the soil cement in
16 those two areas may become weakened by becoming if you
17 will wetter.

18 DR. MITCHELL: If it would become wetter,
19 there is a potential for it then becoming weaker.

20 MR. TRAVIESO-DIAZ: Let me ask you first
21 of all to see if we can define the extent of the
22 problem. Do you expect that there would be water
23 infiltration? I'm assuming it happened. Instead of
24 that question, let me ask you one before. Is it your
25 understanding that the soil cement layer that is

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1 placed around the canister transfer building has
2 essentially the same dimensions as the building?

3 DR. MITCHELL: Yes.

4 MR. TRAVIESO-DIAZ: It's 250 by 280 or so
5 feet.

6 DR. MITCHELL: Yes.

7 MR. TRAVIESO-DIAZ: Would your expectation
8 be that if there is water infiltration underneath that
9 soil cement layer that you're going to have
10 essentially uniform moisture underneath all those 250
11 by 280 feet or would it be more of a localized
12 phenomenon?

13 DR. MITCHELL: I suspect if there is
14 infiltration that it would be reasonably localized.

15 MR. TRAVIESO-DIAZ: Okay. Do you know
16 whether in its stability analysis calculations for the
17 canister transfer building PFS takes credit for the
18 contribution or the entire 250 by 280 feet layer of
19 cement to provide a buttressing effect that they use
20 to address building sliding?

21 DR. MITCHELL: My recollection which may
22 be poor is that they are relying on a passive
23 resistance of the soil cement layer which would
24 involve a distance out from the side of the canister
25 building of a matter of a few, maybe 10 or 15 feet

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1 sort of thing as opposed to the whole area.

2 MR. TRAVIESO-DIAZ: Taking that into
3 consideration, would you consider the potential
4 infiltration assuming there is localized weakening of
5 the subsoil to be a real problem for the canister
6 transfer building?

7 DR. MITCHELL: Unless it's close to the
8 canister transfer building, it probably would not be
9 a major consequence.

10 MR. TRAVIESO-DIAZ: Okay.

11 DR. BARTLETT: I'm not completely
12 convinced there won't be a pathway of water around the
13 canister transfer building immediately adjacent to the
14 canister transfer building due to differential
15 settlement that may occur between the canister
16 transfer building mat and the essentially unloaded
17 soil cement that's around the parameter.

18 MR. TRAVIESO-DIAZ: So you assume that
19 there would be --

20 DR. BARTLETT: There could be a gap that
21 forms.

22 MR. TRAVIESO-DIAZ: A gap that extends the
23 entire length of the soil cement.

24 DR. BARTLETT: I think we're talking about
25 the area just immediately adjacent to the canister

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1 transfer building where passive resistance is
2 required.

3 MR. TRAVIESO-DIAZ: I understand. But the
4 area adjacent to the canister transfer building as far
5 as the soil cement layer, it's concern is five feet
6 thick. Is that right?

7 DR. BARTLETT: Correct.

8 MR. TRAVIESO-DIAZ: So you have to have a
9 gap that is five feet down if you will for the --

10 DR. BARTLETT: In an extreme event, let's
11 say the canister transfer building settles three
12 inches on its mat foundation. The soil cement doesn't
13 settle at all. There will maybe not be a large
14 horizontal gap, but there will be now a pathway.
15 You've cracked the soil cement right there.

16 MR. TRAVIESO-DIAZ: So in this scenario
17 they are talking about, there potentially could be a
18 separation between the five feet of soil cement and
19 the canister transfer building mat.

20 DR. BARTLETT: There won't be so much as
21 a horizontal separation. It'll be a vertical shear
22 that's introduced as the canister transfer building
23 settles downward and the soil cement doesn't settle
24 with it.

25 MR. TRAVIESO-DIAZ: Let's just take the

1 hypothetical one step further. Let's assume that in
2 fact there is some mechanism that allows some of the
3 soil directly near the building to be exposed to
4 humidity or water accumulation. Let's further assume
5 for this discussion that the accumulation of water
6 leads to the weakening of the native soil in that
7 area.

8 DR. BARTLETT: Okay.

9 MR. TRAVIESO-DIAZ: Are you with me on the
10 hypothetical so far?

11 DR. BARTLETT: I'm with you so far.

12 MR. TRAVIESO-DIAZ: Okay. Assume that the
13 soil underneath the soil cement and the air becomes a
14 little weaker by virtue of having water and being
15 moister than it was before.

16 DR. BARTLETT: Okay.

17 MR. TRAVIESO-DIAZ: What difference would
18 that make? Assuming that the rest of the native soil
19 underneath the soil that canister transfer building
20 remains intact?

21 DR. BARTLETT: Well, that's the problem
22 with the assumption I guess. If the mechanism is
23 water infiltrating along the side of the canister
24 transfer building, I have a hard time envisioning how
25 it's going to stay dry underneath the canister

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1 transfer building and wet under the soil cement.

2 The design calculation for the canister
3 transfer building uses the shear resistance mobilized
4 of the soils directly underneath the canister transfer
5 building to participate in resisting the seismic load.
6 Then it uses I believe half of the passive resistance
7 provided by the soil cement. If in your hypothetical
8 question that the soil is immediately underneath the
9 canister transfer building around the parameter are
10 not affected and only the soils underneath the soil
11 cement are affected by this increase in moisture
12 content, it would be inconsequential because PFS
13 hasn't used the shear resistance of the Bonneville
14 clay directly underneath the soil cement in its
15 calculations.

16 MR. TRAVIESO-DIAZ: Let's take the
17 hypothetical one step further.

18 DR. BARTLETT: Okay.

19 MR. TRAVIESO-DIAZ: Assuming that in fact
20 water infiltrated under the mechanism that you
21 postulated down to the layer where the canister
22 transfer building mat ends and where the soil cement
23 adjacent to it ends, how far into the mat or the
24 building in this hypothetical do you assume that the
25 humidity will go?

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1 DR. BARTLETT: I imagine it's a relatively
2 localized effect, a few feet, maybe tens of feet.

3 MR. TRAVIESO-DIAZ: All right. Assuming
4 that the consequence was weakening the soil, that
5 would still be again a localized effect in that area -
6 -

7 DR. BARTLETT: Yes. I have a hard time
8 envisioning this affecting completely the Bonneville
9 clays underneath the entire canister transfer
10 building. I'm not trying to imply that.

11 MR. TRAVIESO-DIAZ: Okay. It could lead
12 perhaps to a local weakening of the soils on both
13 sides if you will of the interface between the
14 canister transfer building and the soil cement. Is
15 that right?

16 DR. BARTLETT: That's right.

17 MR. TRAVIESO-DIAZ: Now, do you think it's
18 reasonable to expect that this will reduce
19 significantly the ability of the soils to provide the
20 resistance that they are assuming the design?

21 DR. BARTLETT: For something as large as
22 a canister transfer building, I think this effect is
23 not one that I'd worry about. I would worry more
24 about it on the footprint size of a pad which is
25 significantly smaller than this effect.

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1 MR. TRAVIESO-DIAZ: All right. There we
2 are talking about actually not the pad, but we're
3 talking about the frame on the pad. Is that right?

4 DR. BARTLETT: Yes. But also if there is
5 infiltration of water along the interface of the
6 concrete pad and down into the Bonneville clay
7 underneath the pad, a migration of a few feet even if
8 it's tens of feet underneath the pad because of its
9 smaller dimensions could be of consequence to the pad.

10 MR. TRAVIESO-DIAZ: I think Dr. Mitchell
11 postulated a few minutes ago that even due to some of
12 the effects that water is not going to be there. It's
13 going to move away. You would have more cracks.

14 DR. BARTLETT: I forgot to take that
15 effect into account. There could be some drying too.

16 MR. TRAVIESO-DIAZ: Thank you. Dr.
17 Mitchell, let's take a look now at answer 28 for your
18 testimony. I'm sorry this is for both for you, but
19 I'll start with you Dr. Mitchell. This deals with an
20 issue that we discussed today. It was discussed
21 yesterday also. It is Young's modulus.

22 In fact, let's take a look at the second
23 paragraph, Dr. Mitchell, first which is they --
24 assumes that your going to have simultaneously a
25 compressive strength of 40 PSI and a Young's modulus

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1 of no more than 75,000 PSI. Do you see that?

2 DR. MITCHELL: I do.

3 MR. TRAVIESO-DIAZ: You understand that
4 that's what the design goes for. Is that right?

5 DR. MITCHELL: Yes.

6 MR. TRAVIESO-DIAZ: When I took your
7 deposition, you said, and correct me if I'm
8 remembering this wrong, to you that was potentially
9 feasible, but you needed to see test results before
10 you were convinced. Is that right?

11 DR. MITCHELL: Yes it is.

12 MR. TRAVIESO-DIAZ: You heard Dr. Wissa
13 testify yesterday that he didn't see much of a
14 difficulty at least conceptually, again subject to
15 proof in meeting both requirements simultaneously
16 because the two requirements are not necessarily
17 consistent with each other. Do you remember that?

18 DR. MITCHELL: Yes.

19 MR. TRAVIESO-DIAZ: Do you agree?

20 DR. MITCHELL: I agree that it is a
21 condition that is achievable. I think it's
22 achievable. The problem that I have is that we're
23 down in a low cement, low modulus range where there's
24 not a lot of data to give us confidence that it's
25 going to be readily attainable. The modulus and the

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1 strength generally are linked for a given soil; the
2 higher the strength, the higher the modulus.

3 The strength being called for here is
4 relatively low. The modulus which has been looked at
5 in a variety of ways and in the testimony that Dr.
6 Ofoegbu gave us yesterday indicated some information
7 sources that suggested it shouldn't be too much of a
8 problem. But here again, it's why can't we do some
9 simple tests and find out for sure.

10 MR. TRAVIESO-DIAZ: All right. Thank you.
11 Dr. Bartlett, just on the first paragraph of the
12 answer 28 which is yours, am I understanding correctly
13 that the paragraph sort of summarizes the concern that
14 is raised in the contention with respect to the type
15 of modulus that we have and how it was obtained and so
16 on?

17 DR. BARTLETT: Yes. I think the concern
18 is that the hypothetical cask tip over event is really
19 a dynamic impact event. We're still having a hard
20 time understanding analytically how one would use a
21 Young's modulus to represent that event in the drop
22 tip over analysis.

23 MR. TRAVIESO-DIAZ: We discussed that
24 again at some length in Salt Lake City if I remember
25 it. Is that right?

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1 DR. BARTLETT: That I don't recall. I
2 think we did.

3 MR. TRAVIESO-DIAZ: I think it was because
4 I was talking to Dr. Ostedon (PH) --

5 DR. BARTLETT: I think it may have been a
6 discussion with Dr. Ostedon (PH), not myself.

7 MR. TRAVIESO-DIAZ: I see. Thank you.
8 Dr. Mitchell, let's move to answer 31 in your
9 testimony. This answer 31 if I understand it ties
10 into or describes two mechanisms that could
11 potentially result in disturbance of the native soils
12 that are used as part of PFS design. Is that right?

13 DR. MITCHELL: I think it does. The
14 answer is really prepared more by my colleague, Dr.
15 Bartlett, however.

16 MR. TRAVIESO-DIAZ: Okay. Why don't I ask
17 both of you? Let me start with you.

18 DR. MITCHELL: Okay.

19 MR. TRAVIESO-DIAZ: Does this answer deal
20 with (a) the potential that there could be disturbance
21 during construction, the construction activities, and
22 (b) there could be a change in moisture content of the
23 soils by the mechanism that we talked about before?

24 DR. MITCHELL: It seems to me that it
25 deals with the disturbance that could be caused during

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1 construction, the property changes, and the Bonneville
2 clay that could result. It talks about the
3 recompacted areas where there's more than two feet of
4 the eolian silt and they'd have to excavate some more
5 and replace it with the recompacted soil.

6 MR. TRAVIESO-DIAZ: Let me ask you about
7 the construction activities. I think we talked about
8 this again in your deposition. Isn't it correct that
9 there are a number of things that can be done during
10 construction to avoid disturbing the native soils?

11 DR. MITCHELL: I believe that was
12 discussed. If I remember correctly, Dr. Wissa talked
13 about that at some point.

14 MR. TRAVIESO-DIAZ: That's also true. Did
15 you hear what Dr. Wissa said yesterday about the
16 things that can be done?

17 DR. MITCHELL: Yes.

18 MR. TRAVIESO-DIAZ: Do you agree that
19 those are things that would alleviate or eliminate
20 this potential problem?

21 DR. MITCHELL: I think they can help
22 minimize any problems from this source.

23 MR. TRAVIESO-DIAZ: Okay. Which of you
24 should be answering questions about remodeling?
25 Either or both of you?

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1 DR. BARTLETT: Probably me.

2 MR. TRAVIESO-DIAZ: All right. Let me
3 talk to you. Tell me again what your concern is about
4 the remodeling of the place.

5 DR. BARTLETT: The Bonneville clays are
6 moderately sensitive. The upper Bonneville clays
7 particularly have high plastic clays and high plastic
8 silts. As I recall, the sensitivities which is a
9 measure of the undisturbed shear strength compared to
10 the remolded shear strength are approximately three to
11 five for this type of clay.

12 MR. TRAVIESO-DIAZ: Okay. Were you here
13 yesterday when it was discussed in the testimony of
14 Mr. Trudeau and Dr. Wissa as to the extent to which
15 there may be a need to use a remolded clay?

16 DR. BARTLETT: Yes I was. Remolded and
17 compacted as I recall.

18 MR. TRAVIESO-DIAZ: Yes. Remolded and
19 compacted. That's right.

20 DR. BARTLETT: That's correct.

21 MR. TRAVIESO-DIAZ: Okay. Did that
22 discussion that they presented help you understand
23 better the potential extent of the problem?

24 DR. BARTLETT: Yes. I understand that
25 there's an intent in certain areas maybe to recompact

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1 the clays particularly in areas where maybe the gap as
2 I think we described it where we need to fill in
3 somewhere between the bottom grade of the pads and the
4 Bonneville clay. My opinion I guess on that process
5 and procedure is that I don't have a good feel for
6 what the strengths of the Bonneville clay are
7 recompacted. I would have to defer to a testing
8 program that would show that you can recompact the
9 Bonneville and achieve those kinds of strengths.

10 I don't know if they're achievable. I
11 don't know if they're not achievable. I just don't
12 have a lot of experience with remolded and recompacted
13 Bonneville clay. We generally don't construct to top
14 it in the Salt Lake Valley because it's covered by 15
15 or 16 feet of alluvium.

16 MR. TRAVIESO-DIAZ: So you don't know
17 where there is information available in the technical
18 literature as to the kind of strengths that can be
19 achieved.

20 DR. BARTLETT: Well, I don't know if you
21 even need to really rely on the literature. This is
22 a simple laboratory test that can be done.

23 MR. TRAVIESO-DIAZ: So in fact, is it your
24 understanding that PFS tends to use, how can I best
25 describe it in layman's terms, sort of compaction or

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1 this remolded clay?

2 DR. BARTLETT: My understanding is in
3 these areas there was I think described part of the
4 program that would take the recompacted clays,
5 obviously compact them to some type of optimum
6 moisture density relationship, and then probably test
7 their shear strength. I would assume that it would be
8 included in a normal program if recompacted clay was
9 to be used.

10 MR. TRAVIESO-DIAZ: You have no reason to
11 believe that this wouldn't work subject of course to
12 testing.

13 DR. BARTLETT: Again, I don't know. I
14 don't have test data at hand to say will it work or
15 will it not work.

16 MR. TRAVIESO-DIAZ: This is for both of
17 you. You would expect that this is something that PFS
18 would test for if they in fact intended to -- with the
19 case to use remolded and compacted clay. Is that
20 right?

21 DR. BARTLETT: Yes. I would expect that
22 to be in the program.

23 MR. TRAVIESO-DIAZ: Is that your
24 expectation also?

25 DR. MITCHELL: I would hope that they

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1 would do the tests. I would suspect that if you took
2 the material, the Bonneville clay, processed it
3 appropriately and compacted it to the right condition,
4 you could get a reasonably high strength. But you
5 might not be able to do that quite so easily in the
6 field. The reason is that the compaction of this
7 material instead of being over a firm subgrade is
8 going to be over a rather deformable subgrade which is
9 the underlying Bonneville clay that you have not
10 excavated. When that happens, the amount of
11 compaction that you can achieve is reduced compared to
12 what you get if compacting over a hard surface. You
13 would have to look at that.

14 MR. TRAVIESO-DIAZ: So that becomes a
15 construction challenge if you will. Right?

16 DR. MITCHELL: Exactly.

17 MR. TRAVIESO-DIAZ: Okay. Let's go, Dr.
18 Mitchell, to answer 32. We already touched on this a
19 little bit. It is the changes of moisture in the
20 clay. Do you see that answer?

21 DR. MITCHELL: Yes.

22 MR. TRAVIESO-DIAZ: Again, my
23 understanding of what you are saying here is that
24 there is some concern that if the native clay
25 underneath the soil cement around the building or

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1 around the pads or under this whole cement if it does
2 accumulate that clay will become weaker because of the
3 increase in moisture content?

4 DR. MITCHELL: If the moisture content
5 increases the clay in all probability would become
6 weaker.

7 MR. TRAVIESO-DIAZ: Would that depend on
8 the properties of the clay?

9 DR. MITCHELL: The extent of softening and
10 weakening, yes.

11 MR. TRAVIESO-DIAZ: Okay. That's right.
12 As a general principle, you would expect that there
13 will be some weakening. The amount of it would be
14 dependant on what the properties of the actual clay
15 are.

16 DR. MITCHELL: It would depend on the
17 relationship between strength and moisture content for
18 that particular soil.

19 MR. TRAVIESO-DIAZ: Okay. I asked you
20 this at the deposition. You said that you didn't
21 know, but I'm going to ask you again to see if you
22 have any new information. Do you know whether PFS has
23 conducted tests on inundated samples of soil?

24 DR. MITCHELL: No. I do not know.

25 MR. TRAVIESO-DIAZ: Okay. Would there be

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1 a relation between the compressibility of the soil and
2 its strengths?

3 DR. MITCHELL: There would be.

4 MR. TRAVIESO-DIAZ: Would it be direct or
5 reverse?

6 DR. MITCHELL: How's the compressibility
7 measured first, I guess. There's a 1-D consolidation
8 test or is this a unconfined compression test.

9 MR. TRAVIESO-DIAZ: I'm not even there.

10 DR. MITCHELL: Okay.

11 MR. TRAVIESO-DIAZ: I'm still trying to
12 figure out physical properties and whether there is a
13 relationship between the compressibility of soil and
14 its strength.

15 DR. MITCHELL: Well, the greater the
16 compressibility, the greater the change in strength
17 that you would likely have relative to the original
18 strength of the soil. I'm trying to see how best to
19 say this. The greater the compressibility, the
20 greater the change in water content there will be for
21 a given change in stress.

22 MR. TRAVIESO-DIAZ: Okay.

23 DR. MITCHELL: That will translate to a
24 greater proportional change in strength. I'm not
25 saying absolute change in strength but proportional

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1 change in strength.

2 MR. TRAVIESO-DIAZ: If you take two soil
3 samples and one is more compressible than the other,
4 would you tend to believe that a sample of soil that
5 is more compressible if wet is going to become weaker
6 or tend to have the strength to reduce more than a
7 sample of soil that has less compressibility?

8 DR. MITCHELL: When expressed relative to
9 the initial strength in each case, yes.

10 MR. TRAVIESO-DIAZ: Right. If I were to
11 tell you and you said that you hadn't seen these tests
12 that PFS performed laboratory tests in which it
13 measured the compressibility of soil samples when they
14 were 100 percent, totally inundated, totally
15 saturated. You determined that there was very little
16 change in compressibility of that soil sample.

17 MS. CHANCELLOR: Your Honor, if this deals
18 with PFS's soil cement testing program that we haven't
19 gotten the results from, then I would object to the
20 question.

21 DR. BARTLETT: This is the soil test
22 program.

23 MS. CHANCELLOR: Oh, okay.

24 DR. BARTLETT: I believe these samples
25 were done in one deconsolidation test to explore the

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1 collapse potential of the soils.

2 MR. TRAVIESO-DIAZ: To clarify, Ms.
3 Chancellor, these were tests that were done I think in
4 1996.

5 MS. CHANCELLOR: That's probably the
6 reason I don't remember them, Mr. Travieso-Diaz.

7 MR. TRAVIESO-DIAZ: Yes. I can't remember
8 that far back myself either. Dr. Mitchell, if I were
9 to tell you, and of course you don't know this
10 directly, that PFS performed as I said compressibility
11 tests on fully saturated samples of soils and
12 determined that there was very little change in
13 compressibility of those soils when they were fully
14 inundated. Would that tend to indicate to you that
15 the strengths of these soils are not that greatly
16 affected by their becoming wet?

17 MS. CHANCELLOR: Is this a hypothetical
18 question?

19 MR. TRAVIESO-DIAZ: Yes. It is
20 hypothetical because he hasn't seen the results.

21 MS. CHANCELLOR: Thank you.

22 DR. MITCHELL: I'm not sure I fully
23 understand the condition you're describing here. Let
24 me see if I do by trying to restate it. Are you
25 saying that they measured the compressibility of the

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1 material as it is and compared it with the
2 compressibility of the material after inundation?

3 MR. TRAVIESO-DIAZ: I believe that's
4 exactly what they did.

5 DR. MITCHELL: And are we measuring this
6 compressibility over the same change in stress?

7 MR. TRAVIESO-DIAZ: I believe that's the
8 case.

9 DR. MITCHELL: And it didn't seem to
10 matter that the material was given access to water.

11 MR. TRAVIESO-DIAZ: Well, actually maybe
12 what we could do is let me show you something and we
13 can talk more completely. One moment. Can we go off
14 the record for a second?

15 CHAIRMAN FARRAR: Off the record.

16 (Whereupon, the foregoing matter went off
17 the record at 11:18 a.m. and went back on
18 the record at 11:19 a.m.)

19 CHAIRMAN FARRAR: On the record.

20 MR. TRAVIESO-DIAZ: I'd like to mark this
21 on the record as PFS Exhibit 230. For the record, PFS
22 230 is a copy of section 2.6.1.11.4 of the -- report,
23 the SAR. It extends from page 2.6-42 to 2.6-44b. The
24 section is entitled Collapse Potential or High -- Dr.
25 Mitchell, I would like you to take a second to review

1 this section if you will. Take whatever time you
2 need.

3 MS. CHANCELLOR: Is there a second
4 exhibit?

5 MR. TRAVIESO-DIAZ: It's only one.

6 CHAIRMAN FARRAR: We have two documents
7 here. One of them goes through page --

8 MR. TRAVIESO-DIAZ: That was a
9 reproduction. We reduced two documents together. The
10 pages run continuously.

11 MS. CHANCELLOR: The table, I believe,
12 would not be a continuous part. The tables are
13 usually at the end of the section.

14 MR. TRAVIESO-DIAZ: Well, I really have to
15 say that this is probably -- Let me redescribe the
16 exhibit then. It consists of and the exhibit has two
17 documents which had to be taken together. It's pages
18 2.6-42 through 2.6-44b of the SAR. It also includes
19 table 2-6/12 of the SAR.

20 CHAIRMAN FARRAR: Just to be sure we're
21 clear, what we have is pages 42, 43, 44, a table, then
22 44a and 44b.

23 MR. TRAVIESO-DIAZ: That is correct.

24 CHAIRMAN FARRAR: The reporters will mark
25 that as PFS Exhibit 230 for identification.

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1 (Whereupon, the above-referred to
2 document was marked as Applicant's
3 Exhibit No. 230 for identification.)

4 MR. TRAVIESO-DIAZ: If the witnesses will
5 take a moment to review that exhibit please.

6 DR. BARTLETT: May I make a comment? It's
7 a little bit difficult here to tell whether all of
8 these samples are from the upper Bonneville clay. My
9 recollection is that the upper Bonneville clay may be
10 present only for about eight, possibly ten feet below
11 ground surface. So I think we need to focus our
12 discussion on certainly those samples that are maybe
13 above ten feet and also those that may be highly
14 plastic because there is uncertainty here whether
15 these are the upper Bonneville clay or perhaps the
16 silt that's immediately below it.

17 MR. TRAVIESO-DIAZ: Since you brought it
18 up, Dr. Bartlett, help us. Which of the samples that
19 are listed on table 2.6-12 would in your view
20 correspond to Bonneville clay?

21 DR. BARTLETT: Again, it's really somewhat
22 difficult. My recollection is this upper Bonneville
23 clay that we've been discussing terminates somewhere
24 between eight to ten feet. One could go through and
25 look maybe at the adjacent cone penetrometer data.

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1 This CTB-N, the first sample U-2D might be
2 a possibility. It's in the 8.5 foot range. It's a
3 plastic silt. Possibly CTB-4, sample U-2E. It's six
4 samples down. I see it's classified as a CH. It may
5 be another possibility. The others may be in the
6 silts below the upper Bonneville clay.

7 MR. TRAVIESO-DIAZ: I see. So again, if
8 you are looking at that table, which are potential
9 candidates here? Can you tell me one more time?

10 DR. BARTLETT: Possibly the first line --

11 MR. TRAVIESO-DIAZ: CTB-N.

12 DR. BARTLETT: Correct.

13 MR. TRAVIESO-DIAZ: Okay.

14 DR. BARTLETT: And possibly CTB-4, sample
15 U-2E.

16 MR. TRAVIESO-DIAZ: All right.

17 (Inaudible.)

18 DR. BARTLETT: I can't tell. I'm just
19 saying that there's a potential they may be in the
20 upper Bonneville clay. It's difficult to say right at
21 this point.

22 MR. TRAVIESO-DIAZ: All right. With that
23 clarification in mind, will you take a look at page
24 2.6-44? That appears to report the results of the
25 tests. You can compare that in the discussion there

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1 in the first full paragraph with the tables we talked
2 about. Doesn't, Dr. Mitchell, first, just looking at
3 the discussion on the text, doesn't the first full
4 paragraph on page 2.6-44 indicate that inundation with
5 a specimen resulted in less than .1 percent additional
6 vertical strain for sustained loadings of more than
7 800 minutes?

8 DR. MITCHELL: I need to interpret this,
9 if I may, because that number certainly doesn't seem
10 to jive with what you would get from looking at this
11 table. So I'm questioning, what is the meaning of
12 sustained loadings, additional vertical strain for
13 sustained loadings of more than 800 minutes?
14 Additional vertical strain from what? From the strain
15 that had already taken place when they first inundated
16 it? See, I can't tell that from this very quick look
17 here.

18 MR. TRAVIESO-DIAZ: Well, if you take
19 perhaps a look at the comment, let's take a look at
20 the first entry in the table that Dr. Bartlett pointed
21 out for us as being potentially applicable to CTBN.

22 DR. MITCHELL: Yes.

23 MR. TRAVIESO-DIAZ: Will you look at the
24 comments on the last column that says, "Inundated 41
25 minutes after application with vertical stress of 2

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1 ksf"? Does that help you?

2 DR. MITCHELL: Yes, and I would suggest,
3 then, we have a look, you see where it says, "initial
4 and final," where it says, "void ratio"?

5 MR. TRAVIESO-DIAZ: Uh-hum.

6 DR. MITCHELL: If we look at the
7 difference between those two numbers, it is something
8 of the order of 0.9. See, it's 2.511 and 1.655?

9 MR. TRAVIESO-DIAZ: Yes.

10 DR. MITCHELL: So the change in void ratio
11 is something of the order of 0.9, and if we divide
12 that by 1 plus the initial value, which is 1 plus 2.5,
13 so we have 0.9 over 3.5, which is of the order of 0.
14 -- what is that, about 2-and-a -- .9 over 3.5 is 2.5,
15 or something of that order. I don't have my
16 calculator right here.

17 So that implies that if you had a layer
18 that is 10-feet thick, simply by inundating it, if I
19 haven't done this incorrectly, you would have 2.5 feet
20 of settlement.

21 DR. BARTLETT: Well, again, the final void
22 ratio could be two things. It might be the void ratio
23 after the end of that wetting cycle. I'm assuming
24 here that a complete consolidation test may have been
25 completed here, and this could have been the final

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1 void ratio.

2 DR. MITCHELL: Yes, I see what you're
3 saying.

4 DR. BARTLETT: The final void ratio. So
5 it's really a little bit difficult to say what this
6 final void ratio is. With this being such a large
7 void ratio change, it might be just the final void
8 ratio at the end of the test at a certainly higher
9 state of stress.

10 DR. MITCHELL: I think I would need to see
11 the record of the whole test that shows how things are
12 changing relative to the loads that are applied.

13 DR. BARTLETT: And I think it's also
14 difficult to draw conclusions based on only one sample
15 and whether it's truly coming from the upper
16 Bonneville clay or the silts below it.

17 MR. TRAVIESO-DIAZ: All right. All those
18 concerns in mind, you would look page 2.6-44 of the
19 SAR again for a moment?

20 DR. BARTLETT: Yes.

21 MR. TRAVIESO-DIAZ: Okay. You look at the
22 second full paragraph on that page which starts with,
23 "These specimens." Look at the second sentence that
24 says, "Comparison of the stress-strain plots of the
25 specimens that were inundated with those that were not

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1 inundated shows that they are nearly the same."

2 Again, you have all these potential
3 methodological questions, but assuming that this
4 statement is correct, would that indicate to you that,
5 at least in terms of the people who wrote the SAR,
6 they believed that the test specimens exhibited little
7 additional compressibility as a result of being
8 inundated?

9 DR. BARTLETT: Well, again, it says,
10 "typically resulted in less than .1 percent," which
11 means to me this is somewhat of an average of lower
12 average. It doesn't talk about individual specimens.

13 My concern here is we may be mixing two
14 geologically-different units that have different
15 compressibility and strain properties. I'm not sure
16 that I can really infer that, based on this limited
17 information that's put in front of us.

18 DR. MITCHELL: The data that are in this
19 exhibit are not adequate to provide confirmation of
20 the statement. But assuming that the data are
21 available and they support what is said here, then
22 they have demonstrated, I think, that it is not a
23 collapsible soil in the usual sense.

24 And I don't think I would expect a
25 Bonneville clay, which is a lake clay, to be a

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1 collapsible soil. I would expect the eolian silk, if
2 anything, to be a more collapsible soil.

3 DR. BARTLETT: Dr. Mitchell is correct;
4 the Bonneville clay is usually not considered to be
5 collapsible.

6 DR. MITCHELL: So I would then have to say
7 that probably this large change in void ratio that
8 they're talking about here is from the beginning of
9 the loading to the very end of the consolidation test
10 under a very high stress.

11 MR. TRAVIESO-DIAZ: All right. Dr.
12 Mitchell, you heard yesterday Dr. Wissa testifying as
13 to a difference, if you will, between the testing
14 process and the construction process in the following
15 respect: If I remember what Dr. Wissa testified, he
16 said, you could achieve a better or greater degree of
17 accuracy in the tests that you conduct in the lab as
18 far as specifying values of soil cement percentages or
19 various other properties, but that in constructing in
20 the field you like to have some flexibility in what
21 actually you achieve through the mixing of
22 fabrications. Remember that testimony?

23 DR. MITCHELL: I do.

24 MR. TRAVIESO-DIAZ: Do you agree that, in
25 fact, do you agree with Dr. Wissa's testimony in that

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1 respect?

2 DR. MITCHELL: I do.

3 MR. TRAVIESO-DIAZ: Now do you also agree
4 that or would you also expect, as Dr. Wissa did, that
5 when you came out with specifications for the
6 construction of the actual soil cement, you would have
7 a base number with a range of plus or minus some
8 percent?

9 DR. MITCHELL: I do. I agree with that.

10 MR. TRAVIESO-DIAZ: And that would be the
11 number practiced in your construction processes, is
12 that right?

13 DR. MITCHELL: Yes.

14 MR. TRAVIESO-DIAZ: And would that plus or
15 minus give the constructor some degree of flexibility
16 in terms of not having to meet precisely the 7
17 percent, for example, content?

18 DR. MITCHELL: It has to be related to the
19 testing program that is used to establish the values,
20 so you have some sense of how much a given change in
21 moisture content, a given change in density, a given
22 change in cement content, how much effect that is
23 going to have on these properties. Here again, we are
24 shooting for a certain minimum strength and maximum
25 modulus, in the case of the cement-treated soil.

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1 Usual practice, usual good practice then
2 is to define a zone within which the contractor can
3 construct that will give materials that satisfy the
4 criteria. As Dr. Wissa indicated, that requires some
5 flexibility on the density and the moisture content,
6 and in this case the cement content.

7 As he indicated, it is quite common to
8 increment the cement content a little bit to be sure
9 that you get the strength. However, here I might want
10 to be a little careful because, if you increment it
11 too much, you're going to get too high a modulus.

12 MR. TRAVIESO-DIAZ: Right. So there is a
13 balancing act that has to be --

14 DR. MITCHELL: Certainly, yes.

15 MR. TRAVIESO-DIAZ: Dr. Bartlett, I have
16 a few questions for you. Going to your answer to
17 Question 22, that's on page 8. So that the record is
18 clear, that answer refers to an out-of-phase motion
19 between the parts and the potential consequences of
20 that out-of-phase motion in a seismic event?

21 DR. BARTLETT: Yes, and the impacts that
22 this out-of-phase motion and the kinematic and
23 inertial interactions that may occur between now the
24 foundation systems and the adjacent soil cement and
25 cement-treated soil. Excuse me, soil cement and the

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1 underlying cement-treated soil.

2 MR. TRAVIESO-DIAZ: Is there any thought
3 here or any concept that is different from what we
4 talked about when we were in Salt Lake City on Part D?

5 DR. BARTLETT: No, it's again expressing
6 the concern about low tensile strength, the inability
7 of this cement-treated soil and soil cement to act as
8 an integrative mat to preclude out-of-phase motion and
9 the consequences once out-of-phase motion develops.

10 MR. TRAVIESO-DIAZ: Another question that
11 I have for you is, and we already have covered most of
12 this in prior questions, but you are referring, I
13 believe it's in answer to Question 31, to a remolding
14 and recompaction of clay?

15 DR. BARTLETT: Yes.

16 MR. TRAVIESO-DIAZ: Okay. We talked about
17 this largely, but I have one follow-up question for
18 you. Is it correct to say that, to the extent that
19 there is a potential concern about recompacted clay,
20 and with its cost, the concern, and so on, would that
21 concern be limited only to those areas in which it is
22 established that the eolian soil layer goes in excess
23 of 2 feet below the bottom of the pads?

24 DR. BARTLETT: When this was written, it
25 was not expressing concern about the areas that are

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1 going to be remolded and recompacted. It was just
2 expressing the concern that, once you expose the
3 Bonneville clays, that one has to be careful in not
4 disturbing them due to any construction, trafficking,
5 and other things. So I don't limit this question to
6 concerns specifically about the recompacted Bonneville
7 clay that we discussed earlier this morning.

8 MR. TRAVIESO-DIAZ: All right, let's do it
9 in two parts then.

10 DR. BARTLETT: Okay, let's do it in two
11 parts.

12 MR. TRAVIESO-DIAZ: Because I remember
13 that we discussed this at your deposition at some
14 length as well, although I don't have the transcript
15 here in front of me.

16 With respect to potential disturbance of
17 the Bonneville clay in the process of construction, if
18 I remember, we talked about things that could be done
19 to avoid that potential problem, and you testified
20 there were a number of things that could be done, is
21 that correct?

22 DR. BARTLETT: It seems to me that there
23 are things that can be done, yes. I have not watched
24 soil cement placed, but it seems like there are things
25 that can be done to minimize this effect.

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1 MR. TRAVIESO-DIAZ: With respect to the
2 second part, which we were talking about earlier,
3 about the potential impact of having to use remolded
4 or recompacted clay in the areas where you had to
5 remove more eolian soil that the design essentially
6 calls for, is that right?

7 DR. BARTLETT: Correct, and I guess what
8 I have just discussed earlier this morning is that in
9 my experience I'm not sure whether you can achieve the
10 same strengths recompacted as you could as undisturbed
11 Bonneville clay.

12 MR. TRAVIESO-DIAZ: One second, please.

13 (Pause.)

14 Mr. Chairman, this is all that I have at
15 the moment, but I would like to move for admission
16 into evidence of Exhibits 228, 228A, and 230.

17 MS. CHANCELLOR: No objection, Your Honor.

18 CHAIRMAN FARRAR: Staff?

19 MR. O'NEILL: No objection, Your Honor.

20 CHAIRMAN FARRAR: All right, 228 and 228A
21 were the transcript and the corrections.

22 MR. TRAVIESO-DIAZ: Yes.

23 CHAIRMAN FARRAR: Those will be admitted.

24 MR. TRAVIESO-DIAZ: And 230 was the SAR
25 section with the table that we just talked about a

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1 moment ago.

2 CHAIRMAN FARRAR: And, Ms. Chancellor,
3 your lack of objection covers that also?

4 MS. CHANCELLOR: That's correct.

5 CHAIRMAN FARRAR: Staff, the same thing?

6 MR. O'NEILL: Yes.

7 CHAIRMAN FARRAR: Then that will be
8 admitted also.

9 [Whereupon, the above-referred-
10 to documents marked as
11 Applicant Exhibits 228, 228A,
12 and 230 for identification were
13 received in evidence.]

14 (Whereupon, the foregoing matter went off
15 the record at 11:41 a.m. and went back on the record
16 at 11:41 a.m.)

17 CHAIRMAN FARRAR: Would it help to take an
18 early lunch break to let you sharpen up your thoughts
19 to see what the PFS counsel covered? It's your
20 option.

21 MR. O'NEILL: I don't think we need a
22 lunch break, but could I have just a couple of
23 minutes?

24 CHAIRMAN FARRAR: Sure.

25 MR. O'NEILL: Just a real short, in-place

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1 break?

2 (Whereupon, the foregoing matter went off
3 the record at 11:42 a.m. and went back on the record
4 at 11:46 a.m.)

5 CROSS EXAMINATION BY MR. O'NEILL

6 MR. O'NEILL: Good morning, Dr. Mitchell,
7 Mr. Bartlett.

8 DR. BARTLETT: Good morning.

9 DR. MITCHELL: Good morning.

10 MR. O'NEILL: Just as a reminder, I'm
11 Martin O'Neill, counsel for NRC staff.

12 My first question is intended to provide
13 a clarification. It is for Dr. Mitchell.

14 In Answer 3 of your testimony on page 3,
15 you make a couple of references to NRC Study
16 Committees. I presume you're referring to the U.S.
17 National Research Council as opposed to the Nuclear
18 Regulatory Commission, correct?

19 DR. MITCHELL: That is correct.

20 MR. O'NEILL: Thank you.

21 If I could direct your attention to Answer
22 5, page 3 of your testimony, I guess this question is
23 for both of you. You refer the PFS's proposed use of
24 soil cement as a new and unique application of this
25 technology that lacks precedent. I recall yesterday,

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1 Dr. Mitchell, that you said that you didn't see
2 anything inherently wrong with the proposed design or
3 uses of soil cement, correct?

4 DR. MITCHELL: That's correct.

5 MR. O'NEILL: I mean your concern stems
6 more from the timing of testing, right? Correct?

7 DR. MITCHELL: At this point, yes.

8 MR. O'NEILL: At this point. So you don't
9 intend to suggest that soil cement or cement-treated
10 soil that's properly constructed and that would attain
11 the specified properties is wholly incapable of
12 providing the sliding resistance or buttressing effect
13 that PFS is seeking?

14 DR. MITCHELL: Well, I don't --

15 MS. CHANCELLOR: Dr. Mitchell can answer
16 to the extent that he can, but Dr. Mitchell is not
17 here as a dynamic analysis expert.

18 MR. O'NEILL: You can answer, and then Dr.
19 Bartlett can.

20 DR. MITCHELL: Okay. It appears to be a
21 situation where it could be used for the purposes
22 indicated. It appears that this is a situation where
23 cement-treated soil and soil cement could be used for
24 the indicated purposes.

25 MR. O'NEILL: Okay, thank you.

1 And, Dr. Bartlett, I guess before we go
2 any further, the point I am trying to get at is, it's
3 not a technical impossibility. I recognize that you
4 have concerns, but it is something that could
5 theoretically be done, correct?

6 DR. BARTLETT: I still have exceptions and
7 I don't think the concept has been fully proven. The
8 fact that it cannot support tensile capacity is a
9 great concern, and the lack of tensile strength does
10 not make the system behave as PFS is putting forth in
11 their design calculations. We consider this a design
12 flaw.

13 JUDGE LAM: Is this a fatal flaw?

14 DR. BARTLETT: I can't tell you, Judge
15 Lam.

16 MR. O'NEILL: If you can't -- yes?

17 DR. BARTLETT: We don't know the magnitude
18 of these pad interaction forces. We saw the
19 calculations by Holtec, but we think that they were
20 done for simplistic case. The magnitude of these
21 interaction forces can be quite large, and how they
22 affect the whole system of pads, particularly the pads
23 on the end, is still a great concern to us.

24 MR. O'NEILL: So if the Applicant wasn't
25 even using soil cement and was relying on the soils,

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1 I mean would tensile capacity still be a concern to
2 you?

3 DR. BARTLETT: Pardon?

4 MR. O'NEILL: If they were relying on the
5 soils themselves and not using any --

6 DR. BARTLETT: Well, that's where the
7 disagreement is. We think there is pad-to-pad
8 interaction, and there's more going on than just
9 simply relying on the compressive strength and shear
10 strength of the soil cement and cement-treated soil.

11 MR. O'NEILL: Running into Part D again.

12 DR. BARTLETT: It could be analyzed. It
13 could be analyzed.

14 MR. O'NEILL: It could be analyzed, but
15 you can't say with 100 percent certainty that it's
16 wholly incapable of providing these intended
17 functions?

18 DR. BARTLETT: I can't --

19 MR. O'NEILL: You know, the buttressing
20 effect and sliding resistance, correct?

21 DR. BARTLETT: Well, the fact that one
22 uses buttressing effect, to me, suggests that there is
23 pad-to-pad interaction because, if you are providing
24 passive resistance from one pad, you're pushing on the
25 adjacent pad. So the buttressing effects are very

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1 controversial on what it's actually doing in the
2 seismic design. We just simply disagree that one can
3 completely ignore the integrated effects of how these
4 pads act and interact with each other.

5 MR. O'NEILL: Well, do soils from
6 structural fill have tensile capacity?

7 DR. BARTLETT: No, not really. I think
8 this point was brought out by Dr. Soler, and I would
9 somewhat agree that, if one is trying to minimize the
10 effect of pad-to-pad interaction, it doesn't make
11 sense to put soil cement between the pads. But you
12 cannot completely even preclude the pad-to-pad
13 interaction by putting a gravel there, too, because
14 gravels will still transmit horizontal forces in
15 compression, and they're poor in tension.

16 MR. O'NEILL: Well, you would agree,
17 though, that over time there's certainly been an
18 increase in the number of what one might consider
19 disparate applications of soil cement, correct? I
20 mean, whether it be for --

21 DR. MITCHELL: It's been used for larger
22 or an increasing number of purposes over time.

23 MR. O'NEILL: Liquefaction protection,
24 spillway foundation mats, substitutes for piles for
25 caissons?

1 DR. MITCHELL: Absolutely.

2 MR. O'NEILL: Yes. Would you agree that,
3 regardless of the specific purpose of each of those
4 applications, that the engineers are also relying on
5 some engineer property of that soil cement or a
6 combination of properties, whether it be compressive
7 strength or shear strength?

8 DR. MITCHELL: Yes.

9 MR. O'NEILL: Yes?

10 DR. MITCHELL: Yes.

11 DR. BARTLETT: The importance of designs
12 not only consider the properties, but how the
13 materials do actually behave and interact with each
14 other, especially in seismic --

15 MR. O'NEILL: I recognize it.

16 Dr. Mitchell, you testified that there is,
17 again, no direct precedent for PFS's proposed use of
18 soil cement as a restraining buttress, okay, and then
19 added that deep soil mixing applications are not at
20 all like the propose PFS use of soil cement. Focusing
21 on the proposed uses as a buttress, a restraining
22 buttress, wouldn't this imply that it is being used to
23 provide resistance to lateral loads?

24 DR. MITCHELL: I'm not sure I fully
25 understand the question. Is it --

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1 MR. O'NEILL: Well, if something is acting
2 as a --

3 DR. MITCHELL: Are you asking if soil
4 cement has or is being used to resist lateral loads?
5 Is that the question?

6 MR. O'NEILL: I'm asking if soil cement is
7 being used to act as a restraining buttress, say, for
8 instance, in the case of the CTB, soil cements being
9 placed around the foundation?

10 DR. MITCHELL: Soil cement has been and it
11 is being used to resist lateral pressures, earth
12 pressures, and it was used, as was pointed out
13 yesterday, in the Central Artery Tunnel Project to
14 restrain the soil on each side of where they were
15 putting in some of their tunnels and other structures
16 to withstand their lateral loads.

17 MR. O'NEILL: Okay, and you indicated that
18 during your deposition? Do you recall that? Yes? So
19 would you consider --

20 MS. CHANCELLOR: Dr. Mitchell, had you
21 finished your answer?

22 DR. MITCHELL: Yes, I have.

23 MS. CHANCELLOR: Okay.

24 MR. O'NEILL: Do you consider the use of
25 soil cement as a restraining buttress to be analogous

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1 to its use to provide resistance to lateral loads?

2 DR. MITCHELL: There are some
3 similarities, yes, in this applications. The PFS
4 application is a dynamic lateral loading, which is not
5 the situation, for example, in the Boston Central
6 Artery Tunnel, and it's not the situation in most
7 retaining wall-type structures that involve soil
8 cement. But --

9 MR. O'NEILL: So a lateral load,
10 nonetheless?

11 DR. MITCHELL: It's still a lateral load,
12 sure.

13 MR. O'NEILL: Soil cement's been used
14 what, at the Koeberg facility? That was a nuclear
15 power plant facility, correct?

16 DR. MITCHELL: That was a nuclear power
17 plant foundation.

18 MR. O'NEILL: Now in the case of the
19 Boston Artery Project, it's being used in connection
20 with subterranean tunnels?

21 DR. MITCHELL: That was in the case that
22 as brought forth yesterday.

23 MR. O'NEILL: The Lambert's?

24 DR. MITCHELL: Yes, the Lambert paper. It
25 was also used at the Bird Island Flats excavation for

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1 open excavation support.

2 MR. O'NEILL: So those would be pretty
3 significant functions or structural engineering
4 functions --

5 DR. MITCHELL: Yes.

6 MR. O'NEILL: -- that it's intended to
7 serve?

8 DR. MITCHELL: And they had a pretty
9 significant failure in the Bird Island Flats one.

10 MR. O'NEILL: Yes, but I presume --

11 DR. MITCHELL: I was saying that in one of
12 the applications in Boston they had a pretty
13 significant failure of a soil cement deep mix wall,
14 not the ones that are in the Lambert's paper, but at
15 another location.

16 MR. O'NEILL: I apologize. I'm cutting
17 you off.

18 So its use in these particular
19 applications I just mentioned would certainly indicate
20 that engineers had some level of confidence in its
21 use, correct?

22 DR. MITCHELL: Growing all the time.

23 MR. O'NEILL: Thank you.

24 In Answer 16, page 70, of your testimony,
25 you made reference to severe exposure conditions at

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1 the site, correct?

2 DR. MITCHELL: Which question are we
3 referring to?

4 MR. O'NEILL: . Answer 16.

5 DR. MITCHELL: Sixteen?

6 MR. O'NEILL: This is for you, Dr.
7 Mitchell. Again, I would presume that in prior
8 applications of soil cement it's been subjected to
9 some fairly severe exposure conditions --

10 DR. MITCHELL: Yes.

11 MR. O'NEILL: -- including hot, cold
12 temperatures, potentially even wave action, I'm
13 assuming, to a dam, correct?

14 DR. MITCHELL: That's right.

15 MR. O'NEILL: And I presume that on
16 numerous occasions it's maintained its integrity?

17 DR. MITCHELL: It has quite well, and in
18 most of these cases there have been some problems that
19 when it is first used in a particular application --
20 you brought up the wave action, the slope protection,
21 and where it's been very, very successfully used, but
22 in the early stages they found that bonding between
23 layers and things of that sort were pretty critical
24 issues. Another is when they are using it for dams,
25 where you have seepage right across compaction planes.

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1 But as these things are used more and more, they find
2 ways to overcome these difficulties.

3 MR. O'NEILL: Thank you.

4 Earlier today, there was some discussion of
5 water and moisture potentially infiltrating cracks
6 that might form in the soil cement, correct?

7 DR. MITCHELL: There was.

8 MR. O'NEILL: Is it possible that, if that
9 water made it into the cracks and subsequently you had
10 a prolonged dry period, that it could equally well
11 evaporate from those cracks, correct?

12 DR. MITCHELL: Yes, it could.

13 MR. O'NEILL: You had also talked about
14 techniques that might be used to minimize your
15 shrinkage and curing cracks, including bituminous
16 sprays or plastic liners. Would you agree that in
17 actually constructing soil cement, using the different
18 lifts, wouldn't each successive lift serve to protect
19 the underlying lie to some degree, to prevent moisture
20 loss?

21 DR. MITCHELL: Well, in the sense that it
22 takes the underlying region further and further away
23 from where the water might come in, yes, it provides
24 protection.

25 MR. O'NEILL: What about the material that

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1 is used to bond each successive lift? That would
2 serve the same function, correct?

3 DR. MITCHELL: Well, it would depend on
4 what the material is, but certainly a bituminous
5 material or some sort of a membrane or epoxy, or
6 whatever, or even a neat cement layer in there would
7 probably be helpful.

8 CHAIRMAN FARRAR: Dr. Mitchell, just so
9 we're clear, what's a "neat cement layer"?

10 DR. MITCHELL: Oh, this would just be
11 cement mixed with water.

12 MR. O'NEILL: Okay, would the fact that
13 you have successive lifts that are presumably bonded
14 together, would that serve to minimize the extent of
15 any cracks that might form, you know, the vertical
16 extent of cracks that might form in a cement-treated
17 soil where the soil cement --

18 DR. MITCHELL: Excuse me. I think it
19 might depend on what is used as that interlayer of
20 material. Something that is high strength would
21 probably cut the cracks off. Something that is low
22 probably would have no effect.

23 MR. O'NEILL: Do you know what type of
24 material might serve to do that?

25 DR. MITCHELL: Well, the cement itself, if

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1 you used, what I referred to as a "neat cement" a
2 minute ago, spread along there, that would certainly
3 tend to cut them off.

4 MR. O'NEILL: , You've made no attempts,
5 neither of you, to quantify the amount of water that,
6 assuming that this particular phenomenon did occur,
7 that could make its way through the cracks and
8 potentially reach the clay, right?

9 DR. MITCHELL: I have not.

10 DR. BARTLETT: No.

11 MR. O'NEILL: Or you haven't attempted to
12 quantify any resulting reductions in shear strength
13 that might occur, correct --

14 DR. MITCHELL: No.

15 MR. O'NEILL: -- if there were to happen?

16 DR. BARTLETT: No. I do remember during
17 discovery quite some time back the State suggested to
18 PFS that it might consider a shear strength testing
19 program that looked in potential variations in
20 moisture content and how they may affect the undering
21 shear strength.

22 MR. O'NEILL: Dr. Bartlett, before there
23 was some discussion of sensitivity, Bonneville
24 clays --

25 DR. BARTLETT: Yes.

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1 MR. O'NEILL: -- I believe today? You
2 mentioned, is it, a ratio of 3 to 5?

3 DR. BARTLETT: Three to five, yes.

4 MR. O'NEILL: . Isn't this ratio --

5 DR. BARTLETT: Oh, excuse me, it's not a
6 ratio; it's a range.

7 MR. O'NEILL: A range?

8 DR. BARTLETT: A range. The sensitivities
9 could be from 3 to 5.

10 MR. O'NEILL: Is this particular range
11 applicable to Bonneville clays that are saturated?

12 DR. BARTLETT: That I cannot comment on.

13 MR. O'NEILL: But the clays at this site,
14 most are partially saturated, correct?

15 DR. BARTLETT: Correct, but I'm not sure
16 what the sensitivities are here.

17 MR. O'NEILL: Thanks.

18 DR. BARTLETT: But there's a possibility
19 that they're sensitive.

20 MR. O'NEILL: There's a possibility that
21 they're not, correct?

22 DR. BARTLETT: Let's demonstrate it.

23 MR. O'NEILL: Dr. Mitchell, do you have
24 any reason to believe that it will be impossible to
25 construct a cement-treated soil with the non-confined

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1 compressive strength of 40 psi if there is some
2 unstabilization in the soils at this site?

3 DR. MITCHELL: I have no reason to believe
4 that it's impossible, no..

5 MR. O'NEILL: And the same question with
6 respect to compressive strength of 250 psi, correct?

7 DR. MITCHELL: Correct.

8 MR. O'NEILL: Now in connection with the
9 need to attain a certain combination of Young's
10 modulus and compressive strength, you know, the 40 psi
11 and the less than or equal to 75,000 psi, you
12 indicated that you thought it might be achievable, but
13 you're entering an area in which there was limited
14 data, correct?

15 DR. MITCHELL: That's correct.

16 MR. O'NEILL: But there is some data that
17 would suggest that for a given soil, or at least for
18 the soil studied, that this particular combination can
19 be attained or has been attained?

20 DR. MITCHELL: For soils of this type that
21 have been studied, I think there's a limited amount of
22 data indicating these low Young's modulus values, but
23 not a lot. That's why I think it's particularly
24 important to get some tests done.

25 MR. O'NEILL: Dr. Mitchell, before you had

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1 indicated as well that you weren't familiar with the
2 intricacies of the NRC, the licensing process and the
3 rules and regulations, correct?

4 DR. MITCHELL: That's correct.

5 MR. O'NEILL: So I would take that to mean
6 that you're not familiar with particular regulatory
7 mechanisms that the NRC may have at its disposal to
8 ensure licensee compliance with commitments that might
9 have been made?

10 DR. MITCHELL: I am not familiar with
11 those rules.

12 MR. O'NEILL: Okay, whether the licensing
13 or post-licensing phase --

14 MS. CHANCELLOR: Objection. He's not
15 familiar.

16 MR. O'NEILL: Okay, fair enough.

17 MR. TURK: I don't think there's any
18 problem with that being put on the record.

19 MS. CHANCELLOR: He's already testified
20 that he's not familiar with NRC regulations. What's
21 the point of asking him another question? I object to
22 the form of the question.

23 MR. TRAVIESO-DIAZ: Are you saying it's
24 asked and answered?

25 MS. CHANCELLOR: Thank you, Mr. Travieso-

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1 Diaz, exactly.

2 MR. TURK: Okay, I would accept it as a
3 stipulation by counsel for the State, Your Honor.

4 MR. O'NEILL: Well, yes, I will just take
5 that, his broader statement to include some of the
6 specifics I was going to ask about.

7 CHAIRMAN FARRAR: I don't think there's a
8 question pending, is there?

9 MR. O'NEILL: Well, the question I'm going
10 to --

11 CHAIRMAN FARRAR: I thought I heard you
12 back away from the question.

13 MR. O'NEILL: Yes. The question I was
14 getting at was --

15 CHAIRMAN FARRAR: If you want to ask a
16 question, ask a question, and we'll see what happens.

17 MR. O'NEILL: Okay. Well, you're not
18 familiar with NRC enforcement --

19 MS. CHANCELLOR: Asked and answered, Your
20 Honor.

21 CHAIRMAN FARRAR: Overruled.

22 MR. O'NEILL: -- particular NRC
23 enforcement mechanisms like in the event that a
24 licensee refused to comply with a given commitment,
25 correct?

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1 DR. MITCHELL: I am not familiar with the
2 rules.

3 MR. O'NEILL: Okay, thank you.

4 I think that's all I have. Could we have
5 a minute here?

6 CHAIRMAN FARRAR: Certainly.

7 MR. O'NEILL: Thank you.

8 (Pause.)

9 MR. O'NEILL: That's all we have. Thank
10 you. I apologize for the delay there. Thank you.

11 CHAIRMAN FARRAR: All right, thank you,
12 Mr. O'Neill.

13 The Board has a couple of questions. Why
14 don't we ask those before lunch, and then, Ms.
15 Chancellor, in case we ask anything that you need to
16 think about during lunch, you'll be able to.

17 EXAMINATION BY THE BOARD

18 JUDGE KLINE: I would just like to get
19 your comments on testimony we heard yesterday from Dr.
20 Trudeau and Dr. Wissa. It appears from their
21 testimony that the Applicant's plan is to set out
22 certain engineering specifications for soil cement and
23 then commit to meet them. The question is, why is
24 that not an adequate engineering plan, given that
25 there is regulatory review or confirmation that the

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1 specs. are or are not met? So why the continual
2 insistence on prior testing?

3 Let me clarify a little more. The entire
4 application really is in the form of a commitment to
5 future performance. So, I mean, why do we have to
6 check the implementation now? Because if we did, we
7 couldn't trust anything. You know, are we really
8 compelled to assume that people, engineers, don't know
9 how to build pads or don't know how to build
10 buildings, and that we have to confirm everything in
11 advance?

12 DR. BARTLETT: Well, I think this is one
13 of precedence. Again, in our view, the use of soil
14 cement in this particular application is somewhat
15 different than other times it has been tried and
16 proven and tested. Obviously, some of my reservations
17 are not solely just with the testing and placement of
18 the soil cement. They have to go back to the
19 fundamental analysis and concepts, about how this is
20 being used in a seismic event to transfer forces.

21 So I guess my objection is not solely just
22 on the properties of the soil cement, but how it is
23 being conceptually used to resist seismic motions. I
24 don't think that has been fully demonstrated. This is
25 a new application, in my viewpoint, and we cannot rely

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1 on any previous precedents, nor cases where we have
2 seen it perform under these types of loading
3 conditions for this type of application and it's
4 successfully been used. So, in my viewpoint, this is
5 a case where we have to be very prudent, both on the
6 analysis side and the materials specification side.

7 JUDGE KLINE: That raises another question
8 in my mind related to your insistence on the
9 significance of attributing tensile strength to
10 concrete. I had understood that engineers never
11 attributed or took credit for tensile strength in
12 concrete, unreinforced concrete.

13 DR. BARTLETT: No, it's generally
14 neglected. The tensile strength in concrete designs
15 is provided by the reinforcing bar.

16 JUDGE KLINE: Yes. So why your continued
17 insistence on the significance of tensile forces when,
18 in fact, as I understand it, the actual analysis
19 doesn't take any credit for them?

20 DR. BARTLETT: Because of the way the
21 system has to perform. We have to remember in an
22 earthquake loadings are cyclic. They go back and
23 forth. The fact that they cycle back and forth, and
24 now we have to remember that we have different masses
25 involved. There are maybe a group of pads, or let's

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1 even look at the case that Dr. Soler did because it's
2 one freshly in our mind, where we had a pad with eight
3 casks and a pad with one cask. These two masses
4 setting atop the Bonneville clay -- well, they're
5 separated by a cement-treated soil layer -- however,
6 have very different fundamental frequencies at which
7 they want to oscillate. It's due to their differences
8 in masses. We call this an inertial effect.

9 That tendency to wanting to vibrate out of
10 phase because of their different frequencies not only
11 introduces compression, but it introduces tension.

12 JUDGE KLINE: I understand that it
13 introduces tension, but why is it you can rely on any
14 kind of cement-manufactured material to resist it, or
15 why is --

16 DR. BARTLETT: I guess the point is,
17 because there's low tensile strength, it cannot resist
18 out-of-phase motions --

19 JUDGE KLINE: Yes.

20 DR. BARTLETT: -- in it by -- it will
21 occur. Whether you like it or not, it will occur.

22 JUDGE KLINE: That's what I am trying to
23 understand, the difference between you and the
24 Applicant on this, because they are saying that it
25 won't occur either, aren't they? They are saying, in

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1 fact, we don't take any credit for it?

2 DR. BARTLETT: The Applicant's, I think,
3 vision of how this system behaves, at least as I
4 understand it, is this soil cement and cement-treated
5 soil in between the pads will make this whole system
6 act somewhat as an integrated unit. It will all move
7 together back and forth.

8 We're saying we have a very different
9 viewpoint of what is going to actually happen during
10 an earthquake, that groups of pads, or even individual
11 pads that are adjacent to each other, will tend to
12 develop this out-of-phase motion, will not move as a
13 uniform body, transferring the forces down to the
14 Bonneville clay. There will be pad-to-pad
15 interaction, transfer of forces laterally from pad to
16 pad or from groups to pad to pad. These are very
17 complex interaction issues of how the system really
18 behaves.

19 JUDGE KLINE: Okay, and I guess we went
20 over that in Salt Lake City a good bit.

21 All right, yesterday we heard testimony
22 that, in particular, vertical cracks are a matter of
23 no significance in the overall structure, and you seem
24 to disagree with that. I guess I need a clearer view
25 of why it is you think vertical cracking in the soil

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1 cement layer is a matter that we should take into
2 account.

3 DR. BARTLETT: Loss of tensile capacity.
4 Once a crack develops, there is no tensile capacity,
5 and then you cannot preclude out-of-phase motion of
6 the two systems.

7 JUDGE KLINE: Oh, okay.

8 DR. BARTLETT: That's the point. That's
9 why you put rebar in concrete design, is so that you
10 tie everything together. Here we have a system where
11 heavily-reinforced pad with a lot of mass on it, and
12 in between an essentially very weak material and
13 tension with no mass. They're going to behave
14 seismically quite different, and they're going to want
15 to interact and go out of phase and cause both tension
16 and compression in the system. The fact you have no
17 tensile capacity -- you cannot make this behave as an
18 entire reinforced mat acting as an integrated unit.

19 JUDGE KLINE: Are you trying to tell us
20 that the engineering design should have had tensile
21 capacity designed into it? Is that --

22 DR. BARTLETT: It would help to minimize
23 the pad-to-pad interaction. It can't completely
24 preclude it, however, because if you remember the
25 analysis that Dr. Soler did, he did an analysis where

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1 he included tensile capacity in the springs, and there
2 was still lateral transfer of forces. But once the
3 tensile capacity is lost, the out-of-phase motion is
4 even more pronounced and the interaction forces will
5 be larger.

6 So I guess you can't completely preclude
7 -- the fact that you put a stiffened soil cement in
8 between these pads, in my vision, it acts as a strut.
9 It's much stiffer than the interlying Bonneville clay.
10 As you try to load two materials, the stiffer
11 material, like the soil cement, will pick up the load
12 and transfer the load. The Bonneville clays will try
13 to strain, and it is a very complex loading scenario
14 we're talking about.

15 This simple idea that it's all transferred
16 downward, in our mind, is a fallacy. There's lateral
17 transfer of load in the system that hasn't been
18 accounted for.

19 JUDGE KLINE: Okay, assuming that all of
20 that is true, have you tied it, in your mind, then, to
21 safety consequences?

22 DR. BARTLETT: Well, I think, again, our
23 thinking has been from the foundation and foundation
24 engineering viewpoint. I certainly could see some
25 cases where this transfer of inertial load from one

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1 pad to another, in combination with the inertial loads
2 that an individual pad has to resist, may cause pads
3 to start to slide, maybe particularly worried about
4 the end pads in a row and what happens to them.

5 Then we have a case of sliding now of a
6 pad. How that affects the consequences, it's
7 difficult. I'm not sure any analysis I have seen thus
8 far, either done by Holtec, even the Luke Report, have
9 fully captured our concerns. Whether it will
10 eventually lead to tipping of the casks over, I can't
11 say, but I know that there is a potential now for
12 sliding of a pad itself.

13 I guess the philosophy that I have seen
14 put forth by PFS, by including the soil cement and
15 cement-treated soil, is to not reach that condition of
16 sliding. We say that there would be a potential that
17 sliding could occur. The impacts of sliding on the
18 overall safety I am not sure I can comment on.

19 JUDGE KLINE: If either of you had been
20 called on to design this project in the first
21 instance, what would you have done?

22 DR. BARTLETT: I would have anchored the
23 casks to the pads and used the foundation system that
24 went below the Bonneville clay, so that we can bypass
25 all these compressibility and force shear strength

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1 issues. It's that simple.

2 JUDGE KLINE: Dr. Mitchell, do you have --

3 DR. MITCHELL: I, of course, have come
4 into this project very, very late in the game.

5 JUDGE KLINE: Okay.

6 DR. MITCHELL: It would be helpful for me
7 in answering that question if I had a better
8 understanding of the overall concept. I'm not sure I
9 can give a useful answer.

10 JUDGE KLINE: That's all right. That's
11 all right. Okay, thank you.

12 JUDGE LAM: I have one follow-up question
13 to Dr. Mitchell. As a recognized expert in the field
14 of soil cement, do you see anything fatally flawed
15 with the Applicant's design?

16 DR. MITCHELL: A fatal flaw?

17 JUDGE LAM: Is there any show-stopper
18 there?

19 DR. MITCHELL: At this point, and assuming
20 that they can come up with the properties that they
21 are calling for, I don't think there is a fatal flaw
22 as regards the ability to construct and meet the
23 criteria that they have established. There may be the
24 fatal flaw that Dr. Bartlett is referring to here
25 about the performance.

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1 I think I would be more comfortable if
2 there were some dynamic analysis of this whole system
3 under a reasonable earthquake motion to see just what
4 the response might be. Now there may be some analyses
5 that I'm unaware of, but the amount of sliding perhaps
6 can be estimated from that kind of an analysis, and we
7 can get a better understanding of whether the cracking
8 and the out-of-phase motions will, indeed, develop.

9 JUDGE LAM: Thank you, Dr. Mitchell.

10 CHAIRMAN FARRAR: Let me just ask one
11 followup on this question of fatal flaw and your
12 answer. Is there anything you are aware of that
13 necessarily precludes them from coming up with the
14 right mix of soil cement and cement-treated soil? I'm
15 not asking whether they will do so, but is there
16 anything that necessarily will keep them from meeting
17 it?

18 DR. MITCHELL: I am unaware of any at this
19 point.

20 CHAIRMAN FARRAR: Dr. Wissa, your plane is
21 what time from where?

22 DR. WISSA: It leaves at 6:00 p.m.

23 CHAIRMAN FARRAR: 6:00 p.m. from downtown.
24 All right.

25 How did the hour at lunch work yesterday?

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1 Is that enough time for people?

2 MS. CHANCELLOR: Yes, that's fine, Your
3 Honor.

4 CHAIRMAN FARRAR: Do we need to shorten
5 it? Well, Ms. Chancellor, how much redirect do you
6 think you have?

7 MS. CHANCELLOR: I have very little
8 redirect. I will have more rebuttal than I will
9 redirect.

10 CHAIRMAN FARRAR: Off the record.

11 (Whereupon, the foregoing matter went off
12 the record at 12:24 p.m. and went back on the record
13 at 12:24 p.m.)

14 CHAIRMAN FARRAR: It is 12:25 p.m. Off
15 the record.

16 (Whereupon, the foregoing matter went off
17 the record at 12:25 p.m. for lunch and went back on
18 the record following lunch at 1:26 p.m.)

19 CHAIRMAN FARRAR: On the record. It looks
20 like we are ready to start, Ms. Chancellor, with your
21 redirect.

22 MS. CHANCELLOR: That's correct, Your
23 Honor.

24 REDIRECT EXAMINATION

25 MS. CHANCELLOR: Good afternoon. Dr.

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1 Mitchell just a little carry over from Dr. Wissa's
2 testimony that we said we'd get to in your redirect.
3 Do you recall the discussion when I was showing Dr.
4 Wissa the AGECE test results and the definition of CH
5 and MH came up. Could you tell us how these terms, CH
6 and MH, are derived?

7 DR. MITCHELL: They are part of the
8 uniform soil classification system which is pretty
9 much in use throughout the country by most
10 organizations. It's a unified soil classification
11 system. It's a two letter descriptor for the soil.
12 S is sand. G is gravel. C is clay and we still have
13 to worry about silt and we've already used S.

14 So much of the classification of the finer
15 grain soils is derived from work that was done in
16 Sweden many years ago by a man named Attenberg and so
17 hence the Attenberg limits. I think out of respect
18 for what they did in Sweden they used the Swedish word
19 for silt which is moh M-O-H. They picked up the M so
20 now we have G, C, M and S. The other term you will
21 see is an L for low and that means low plasticity and
22 H for high plasticity. That's how we get these terms.
23 So a MH is a high plasticity silt.

24 MR. TRAVIESO-DIAZ: Next time they accuse
25 lawyers of complicating things I have an example to

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1 come back with.

2 MS. CHANCELLOR: Yes, but Dr. Mitchell can
3 explain it.

4 MR. TRAVIESO-DIAZ: We are grateful for
5 that.

6 MS. CHANCELLOR: Dr. Bartlett, Judge Lam
7 asked you why the state didn't conduct its own
8 analysis of the problems with soil-cement and cement -
9 treated soil. You responded that it was basically
10 lack of resources. Are there any other reasons that
11 you can think of why the state wouldn't have conducted
12 its own analysis?

13 DR. BARTLETT: When I first got involved
14 with Private Fuel Storage I was working for the
15 Department of Transportation. At that time I was
16 really not even retained by the state because I was
17 a state employee. My role was mainly just review.
18 That role I think stayed pretty much the same.

19 We looked at our capacity as mainly review
20 of calculations and not to really proffer new
21 calculations. We felt that's what the applicant does.
22 It is tempting from time to time as an engineer to
23 want to do your own calculations but it was mainly
24 that we were in a review capacity. That's what we
25 were performing.

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1 MS. CHANCELLOR: So you considered it a
2 peer review.

3 DR. BARTLETT: Yes, just a peer review.

4 MS. CHANCELLOR: You didn't expect to do
5 a competing analysis.

6 DR. BARTLETT: No, I never intended to.

7 MS. CHANCELLOR: Dr. Mitchell, you
8 testified in response to Mr. Travieso-Diaz that
9 Young's modulus could increase with time from the time
10 that it is measured in the lab. Could you explain why
11 that is so?

12 DR. MITCHELL: Yes, the strength and
13 stiffness of cement-treated soils doesn't just
14 increase all at once and then stop but like concrete
15 it continues to cure with time. As a result the
16 compressive strength and stiffness are likely to
17 continually increase for some time period, months or
18 years, after you first form the material. This could
19 be significant relative to the 75,000 psi limit that
20 has been prescribed by PSF for their material.

21 If the laboratory testing program and the
22 field construction give you an initial value of 75,000
23 psi within 28 days and incidentally I don't recall
24 seeing anywhere where the time at which the strengths
25 that are prescribed in these modulus values are

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1 prescribed have been specified whether they are seven
2 days, 28 days or some other time period after forming
3 specimens.

4 But in the event that you have that 75,000
5 at that particular time and let's say it's 28 days
6 after making the sample, a year later it could be
7 100,000 psi or some other value that will be
8 undoubtedly higher than the initial value. Therefore
9 it would seem if your goal is to limit the modulus to
10 75,000 psi over the long term, it will be desirable to
11 have a lower design value than the 75,000 psi
12 initially.

13 MS. CHANCELLOR: Dr. Mitchell, would this
14 mean that there's a fairly narrow range when you are
15 trying to meet Young's modulus over let's say the 40
16 year life of the facility and the 40 psi compressive
17 strength of the cement-treated soil?

18 DR. MITCHELL: Well the 40 psi compressive
19 strength is a lower value so it can be higher than
20 that. That should be no problem. The concern is
21 keeping the Young's modulus below 75,000 to meet the
22 criteria established for the cast drop or tip over
23 whatever those cases are. That would seem to me to
24 require giving some consideration to the changes in
25 these properties with time after making the samples.

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1 MS. CHANCELLOR: Thank you. Do you recall
2 responding to Mr. Travieso-Diaz that you were talking
3 about the test that Dr. Wissa was going to perform for
4 the static Young's modulus. It was a stress to strain
5 ratio. Is that how it's measured? How Dr. Wissa or
6 how PFS --

7 DR. MITCHELL: My recollection of what Dr.
8 Wissa is proposing to do was to take the initial
9 tangent modulus from a compression test of the soil-
10 cement.

11 MS. CHANCELLOR: Can you use a static
12 modulus for dynamic analysis?

13 DR. MITCHELL: If you are able to
14 correctly take into account the effect of the dynamic
15 loading as opposed to the slower so-called static
16 loading and if you are able to account for any strain
17 dependence that there might be on the modulus itself.

18 MS. CHANCELLOR: So the effective modulus
19 if you will to describe the dynamic response could
20 that be different from the static modulus?

21 DR. MITCHELL: I would expect to get a
22 different modulus under dynamic loading but with
23 respect to the particular calculations being made here
24 I don't know enough of the inner workings of the
25 program that they are using or the details of the

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1 assumptions other than to look at one of these reports
2 of theirs that simply list 75,000 psi in the table. I
3 don't know what they do with it from there on.

4 MS. CHANCELLOR: Would you anticipate that
5 a static modulus would be higher or lower than a
6 dynamic modulus?

7 DR. MITCHELL: Lower.

8 MS. CHANCELLOR: By very much?

9 DR. MITCHELL: I think it could be quite
10 a bit I suppose. You could be up to 100 percent or
11 so.

12 MS. CHANCELLOR: That's all I have, Your
13 Honor.

14 CHAIRMAN FARRAR: Any recross by the
15 Applicant?

16 MR. TRAVIESO-DIAZ: I think I have
17 approximately three questions.

18 CHAIRMAN FARRAR: Okay. Go ahead.

19 RECROSS EXAMINATION

20 MR. TRAVIESO-DIAZ: The first one I think
21 is a single question. You testified that in the case
22 of the use of soil-cement for the Bird Island Flat
23 excavation that was a failure.

24 DR. MITCHELL: Yes.

25 MR. TRAVIESO-DIAZ: Could you explain what

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1 the nature of the failure was and how it occurred?

2 DR. MITCHELL: This was an excavation
3 retention structure which was a line of deep soil
4 mixed columns and a tied back excavation and one of
5 the walls underwent substantial deformations and
6 displacements.

7 MR. TRAVIESO-DIAZ: But that was not a
8 failure of the soil-cement pigment itself, was it?

9 DR. MITCHELL: I don't think it was as far
10 as I know and there's debate on the issue. Some will
11 argue that it perhaps was the cement but it seems in
12 my view anyhow more logically a failure to use the
13 right strength of the soil being retained behind the
14 wall.

15 MR. TRAVIESO-DIAZ: So that failure
16 doesn't undercut the testimony that you gave earlier
17 as to the fact that this was a valid use of soil-
18 cement for that application.

19 DR. MITCHELL: It was a valid use of soil-
20 cement.

21 MR. TRAVIESO-DIAZ: Okay. Let's talk
22 about Young's modulus for a second and this is where
23 we have one, two or three questions. First of all as
24 to the first set of questions that Ms. Chancellor
25 asked you, you said that because of the fact that

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1 Young's modulus may increase with time your
2 recommendation to PFS would be that they don't try to
3 get just 75,000 but they shoot for less to have some
4 room.

5 DR. MITCHELL: That would be one way to
6 approach it. I think some tests that determine the
7 rate of strength gain in modulus change as a function
8 of time in the testing program could shed a great deal
9 of light on the question.

10 MR. TRAVIESO-DIAZ: And you understand of
11 course that the 75,000 is maximum.

12 DR. MITCHELL: Yes it is.

13 MR. TRAVIESO-DIAZ: So PFS came up with 40
14 pounds per square inch and 40,000 they would probably
15 be happy as well. Right?

16 DR. MITCHELL: They need 45 psi. That's
17 a minimum as I understand it. Forty-five psi
18 compressive strength is a minimum. 75,000 psi modulus
19 is a maximum.

20 MR. TRAVIESO-DIAZ: I thought it was 40.
21 But putting that aside --

22 DR. MITCHELL: It is 40. I'm sorry.

23 MR. TRAVIESO-DIAZ: My question is if they
24 compressive strength and they were able to determine
25 that for the mix they use the modulus was say 50,000

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1 say 50,000 that wouldn't be a problem, would it?

2 DR. MITCHELL: It depends on what the rate
3 of gain of modulus is over time.

4 MR. TRAVIESO-DIAZ: Okay but how low do
5 you think the modulus will have to get before you
6 could expect it not to increase over time over the
7 75,000?

8 DR. MITCHELL: I suppose it might be in
9 order of half. Say 40,000 psi perhaps. I don't know
10 without data.

11 MR. TRAVIESO-DIAZ: But in any event, your
12 comment there was more in the nature of saying you
13 better not try to just hit 75,000 because even if you
14 do you may end up having more in the future. Is that
15 right?

16 DR. MITCHELL: That's correct.

17 MR. TRAVIESO-DIAZ: The second set of
18 questions is when we were talking about static versus
19 dynamic modulus. Do you know what type of modulus is
20 required for the tip over analysis that Holtec
21 performed?

22 DR. MITCHELL: All I know is that in the
23 analysis that I just had a chance to scan they
24 tabulate some values that were used in their computer
25 program and it said E 75,000 psi. But I don't know

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1 what the numerical modeling is doing in that program.

2 MR. TRAVIESO-DIAZ: Okay. The comments
3 that you were making about static modulus being higher
4 than dynamic and so on, those are general comments
5 based on your understanding of how a modulus behaves.
6 Is that right?

7 DR. MITCHELL: Yes, and the general
8 comment is that the dynamic is higher than the static
9 one. I think you just said that the static was
10 higher.

11 MR. TRAVIESO-DIAZ: I apologize. Whatever
12 I said you are the witness. But you don't know really
13 which is the proper modulus to use for the particular
14 application that PFS is intending to use here, do you?

15 DR. MITCHELL: I don't know that because
16 as I indicated I don't know the details of the
17 analysis.

18 MR. TRAVIESO-DIAZ: Thank you. That's all
19 I have. It's approximately three.

20 CHAIRMAN FARRAR: Any recross by the
21 staff?

22 MR. O'NEILL: Yes, Your Honor.

23 MR. TURK: Your Honor, would it be
24 objectional if I conducted the limited recross?

25 MR. O'NEILL: Not to us.

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1 MR. TURK: Just a few questions.

2 MS. CHANCELLOR: It's very difficult with
3 tag teaming but I'll reserve judgement.

4 CHAIRMAN FARRAR: In the interest of
5 efficiency, we'll permit it. Go ahead, Mr. Turk.

6 RE CROSS EXAMINATION

7 MR. TURK: My first question is to Dr.
8 Mitchell. In testimony earlier today, Dr. Bartlett
9 was pointing out that the problems had interaction
10 which the state postulates could occur in the event of
11 a seismic event. In your testimony you mentioned that
12 the soil-cement could crush. Could you explain that
13 crushing phenomenon?

14 MS. CHANCELLOR: Your Honor, I don't mind
15 Mr. Turk asking questions provided it is limited to
16 recross. I don't want this to just start out as a
17 whole new cross examination because they had their
18 chance first time around on that.

19 MR. TURK: This was something that was
20 mentioned when Dr. Mitchell mentioned crushing that
21 was in the original testimony but then during Board
22 questioning Dr. Bartlett proceeded to explain again
23 the concerns faced by the state.

24 MS. CHANCELLOR: That is fine if it's in
25 response to the Judges' questions.

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1 CHAIRMAN FARRAR: Yes, it has to be.
2 Since Mr. O'Neill went we have had Board questions
3 then a relatively brief examination by Ms. Chancellor
4 and Mr. Travieso-Diaz so as long as it's within that
5 scope. Did you finish the question?

6 MR. TURK: I believe so, yes. Do you want
7 me to repeat it?

8 DR. MITCHELL: Could you repeat it please?

9 MR. TURK: In the event that the state is
10 correct that there would be pad interaction whereby in
11 a seismic event one pad moves and somehow bumps up
12 against the pad next to it through the soil-cement,
13 what would happen in the soil-cement as that motion
14 from one pad is directed to the pad adjacent to it?

15 DR. MITCHELL: I can't say with any
16 certainty what would happen. I can only surmise what
17 might or could happen. That is with these relatively
18 brittle elements banging into each other you could
19 begin to do a little crushing of the material in the
20 zone of contact.

21 MR. TURK: And when you say crushing of
22 the material you mean the soil-cement material.

23 DR. MITCHELL: Soil-cement material, yes.

24 MR. TURK: When that happens is the force
25 that is being transmitted from one pad in the

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1 direction of the adjacent pad is that energy then
2 dissipated to some extent within the soil-cement.

3 DR. MITCHELL: I would expect it to be
4 dissipated to some extent in that event. Yes.

5 MR. TURK: The Young's modulus. You
6 indicated that both strength and stiffness increase
7 with time so that the Young's modulus would increase
8 from the time that the material is originally to the
9 time that it cures at 28 days and then for some time
10 in the future. My understanding of the curve if we
11 look at a graph in which the vertical axis is
12 strength. That's the Y axis.

13 DR. MITCHELL: Yes.

14 MR. TURK: And the horizontal axis is
15 time. My understanding of the typical Young's modulus
16 curve would show that most of the increase in the
17 Young's modulus would occur before you get to 28 days.
18 Is that consistent with your understanding?

19 DR. MITCHELL: I understand what you are
20 saying. I think that there is in general a constant
21 ratio between the modulus and the compressive
22 strength. I think Dr. Ofoegu was referring to that
23 yesterday in one of the reference that was cited and
24 there's a number of 350 the ratio of E to cube of U I
25 believe. Correct me if I'm wrong. I think it was

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1 something of that order.

2 I think that tends to hold reasonably
3 constant so that the increase in modulus would
4 parallel the increase in strength. It is true that
5 you go from a very low strength to a significantly
6 higher strength within a short time when the cement
7 begins to cure or when it sets so to speak.

8 But generally you follow a path where the
9 strength and modulus are increasing at a decreasing
10 rate over time. For the sake of argument you might
11 double between seven and 14 days, double again between
12 14 and 28, double again between 28 and 56 and that
13 kind of a progression. So it's an ever decreasing
14 rate but I think the strength and modulus parallel
15 each other.

16 MR. TURK: If I'm not mistaken the net
17 effect of that would be that the greatest amount of
18 the delta in the Young's modulus would occur by the
19 time you reach 28 days of curing.

20 DR. MITCHELL: I would expect that to be
21 the case.

22 MR. TURK: Is that one of the reasons why
23 Young's modulus is typically measured at a 28 day cure
24 time?

25 DR. MITCHELL: I don't know as the modulus

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1 measurement would have been the one that sets those
2 times. It's probably the strength if you go back to
3 what people have done historically. They speak in
4 terms of seven day strengths and 28 day strengths are
5 the two most commonly measured. I don't know what age
6 strengths in modulus PFS is proposing to use here.

7 MR. TURK: That's all we have, Your Honor.

8 CHAIRMAN FARRAR: Okay. The Board has no
9 further questions. Ms. Chancellor, do you need
10 another opportunity?

11 MS. CHANCELLOR: Just one or two
12 questions, Your Honor.

13 CHAIRMAN FARRAR: All right.

14 REDIRECT EXAMINATION

15 MS. CHANCELLOR: Dr. Mitchell, this may
16 sound very rudimentary to you. When you were speaking
17 with Mr. Travieso-Diaz you mention reviewing Holtec's
18 dynamic calculations, the cast tip over calculation.
19 You said in there you saw $E = 75,000$ psi. What does
20 E mean?

21 DR. MITCHELL: That's the Young's modulus
22 which is my understanding of that in that figure
23 calculation.

24 MS. CHANCELLOR: It's capital E, right?

25 DR. MITCHELL: Capital E, yes.

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1 MS. CHANCELLOR: Have you changed your
2 mind at all about the need to see additional test data
3 your comment before about show me, trust me?

4 DR. MITCHELL: No, I still would prefer to
5 see it now even recognizing that the people with the
6 most to lose presumably from what I heard this morning
7 is PFS if it doesn't work.

8 MS. CHANCELLOR: Thank you, Dr. Mitchell.
9 No further questions, Your Honor.

10 CHAIRMAN FARRAR: Thank you, Ms.
11 Chancellor.

12 MR. TRAVIESO-DIAZ: I have approximately
13 one question.

14 CHAIRMAN FARRAR: You told me
15 approximately three last time.

16 MR. TRAVIESO-DIAZ: And it was four.

17 CHAIRMAN FARRAR: In the interest of
18 saving time I will not have the court reporter play
19 the many questions you asked.

20 RE CROSS EXAMINATION (con't)

21 MR. TRAVIESO-DIAZ: Dr. Mitchell, you said
22 that you didn't know for sure what the assumption was
23 that was made by PFS in those Holtec analysis that you
24 reviewed as to when the Young's modulus would be
25 measured. If in fact the assumption there that it was

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1 at the end of 28 day curing time, would that result in
2 having as you discussed with Mr. Turk much of the
3 increase in Young's modulus had taken place by the
4 time that the measurement was taken?

5 DR. MITCHELL: I think relative to the
6 value for the untreated soil, the cement-treated soil
7 would now have a significantly higher modulus. I
8 think that it would continue to increase over time for
9 quite some time thereafter.

10 MR. TRAVIESO-DIAZ: That's the one
11 question that I have.

12 CHAIRMAN FARRAR: Okay, thank you. Mr.
13 O'Neill. Mr. Turk.

14 MR. TURK: No, Your Honor.

15 CHAIRMAN FARRAR: So we are done?

16 MS. CHANCELLOR: We're done.

17 CHAIRMAN FARRAR: All right. Thank you,
18 gentlemen. I appreciate you coming to share your
19 expertise with us. Dr. Mitchell, you are excused or
20 no.

21 MS. CHANCELLOR: Definitely not, Your
22 Honor.

23 CHAIRMAN FARRAR: Okay.

24 MR. TRAVIESO-DIAZ: Are we ready to go?

25 CHAIRMAN FARRAR: Yes.

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1 MR. TRAVIESO-DIAZ: Mr. Chairman, in the
2 interest of fair distribution of labor, Mr. Nelson
3 will be handling the rebuttal.

4 CHAIRMAN FARRAR: All right.

5 Whereupon,

6 DR. ANWAR WISSA

7 having been previously duly sworn, the witness was
8 examined and testified further as follows:

9 Whereupon,

10 MR. PETER TRUDEAU

11 having been previously duly sworn, the witness was
12 examined and testified further as follows:

13 REBUTTAL EXAMINATION

14 MR. NELSON: Mr. Trudeau, Dr. Wissa, do
15 you have in front of you a document entitled "Rebuttal
16 Testimony of Paul J. Trudeau and Anwar E.Z. Wissa to
17 Direct Testimony of State of Utah Witnesses Dr. Steven
18 F. Bartlett and James K. Mitchell on Section C of
19 Unified Contention Utah L/QQ"?

20 DR. WISSA: Yes.

21 MR. TRUDEAU: Yes.

22 MR. NELSON: Was this document prepared by
23 both of you or under your supervision?

24 DR. WISSA: Yes.

25 MR. TRUDEAU: Yes.

NEAL R. GROSS

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WASHINGTON, D.C. 20005-3701

1 MR. NELSON: Is this document complete and
2 correct to the best of your information and belief?

3 DR. WISSA: Yes.

4 MR. TRUDEAU: Yes.

5 MR. NELSON: And do you adopt it as your
6 rebuttal testimony in this proceeding?

7 MR. TRUDEAU: Yes.

8 DR. WISSA: Yes.

9 MR. NELSON: I move that this rebuttal
10 testimony be admitted and bound into the record as if
11 read.

12 CHAIRMAN FARRAR: Any objection?

13 MS. CHANCELLOR: No objection, Your Honor.

14 MR. O'NEILL: No objection, Your Honor.

15 CHAIRMAN FARRAR: The rebuttal testimony
16 just handed out will be bound in the record by the
17 reporter at this point as if read.

18 (Insert prefield testimony of Dr. Wissa
19 and Mr. Trudeau.)

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