

CONDENSED TRANSCRIPT

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UNITED STATES OF AMERICA

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NUCLEAR REGULATORY COMMISSION

OFFICE OF THE SECRETARY
RULEMAKINGS AND
ADJUDICATIONS STAFF

Before the Atomic Safety and Licensing Board

In the Matter of) Docket No. 72-22
) ASLPB No. 97-732-02-ISFSI
PRIVATE FUEL STORAGE)
L.L.C.) DEPOSITION OF:
)
(Private Fuel Storage) <u>GEORGE H. C. LIANG</u>
Facility))
) (Utah Contention O)

Tuesday, April 17, 2001 - 9:14 a.m.

Location: Heber Wells Building

160 East 300 South

Salt Lake City, Utah

Reporter: Vicky McDaniel

Notary Public in and for the State of Utah

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In the Matter of Private Fuel Storage
George H. C. Liang * April 17, 2001

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P R O C E E D I N G S

GEORGE H. C. LIANG,

having first been duly sworn to tell the truth,
was examined and testified as follows:

EXAMINATION

BY MR. SEEL:

We're here today in the matter of Private
Fuel Storage, LLC before the Atomic Safety Licensing
Board in a matter to license a nuclear fuel storage
facility in Skull Valley.

Q. Would you please state your name and
address.

A. My name is George H.C. Liang. My business
address is 100 Technology Drive Center, Stoughton,
Massachusetts.

Q. My name is Kurt Seel. I'm an assistant
attorney general for the State of Utah, and I will be
taking your deposition today in the matter of Utah
Contention O. Are you familiar with Contention O?

A. Yes.

Q. And it's my understanding you've been named
as an expert witness in regards to Contention O.

A. Yes.

Q. Mr. Liang, have you been deposed before?
Have you been deposed before? Have you had your

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A P P E A R A N C E S

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Washington, D.C. 20555
Also Present: John Mann

I N D E X

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deposition taken previously?

A. No.

Q. Ever?

A. No -- yes. Ever? I never have a deposition
before.

Q. In this or any other matter?

A. Yeah.

Q. In that case, let me explain a little bit of
a background. Do you understand how the deposition
procedure works? I will be giving you a series of
questions for you to answer.

A. Yes.

Q. If there's any ambiguity or if you don't
understand the question --

A. Uh-huh.

Q. -- please ask me to clarify the question.
Otherwise, I will assume that you understand what's
being asked.

A. Okay.

Q. If you want to take a break, please go ahead
and ask to take a break, and we will take breaks
periodically. Only thing I ask is that you don't take a
break while there's a question on the table. In other
words, if I ask a question, I ask that you answer that
before you ask to take a break.

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1 A. Okay.

2 Q. Do you have any questions at this time as to
3 how this is going to proceed?

4 A. No.

5 Q. I'm now going to ask you a series of
6 questions that relate to you being an expert and the
7 topics for which you have been put forth as an expert in
8 this matter. What I'm trying to do is find out where
9 you're an expert and then put boundaries on where you're
10 going to be giving expert opinions in this matter, and
11 so that's the purpose behind a lot of these questions.

12 What is your educational background?

13 A. My education background, I did my undergrad
14 in Taiwan, National Taiwan University. My major is in
15 civil engineering. Then I did my graduate study at the
16 University of Connecticut at the time where my focus is
17 in the flow mechanics area, and that including
18 hydrology, some other area like groundwater. Then I did
19 my Ph.D. at the University of Connecticut. Focus mainly
20 is wind and wave. I did my thesis in a laboratory wind
21 tunnel 55 feet and then bring wind over the water
22 surface, observe what's the mechanism between the air
23 and the wave and the water.

24 Q. Since you graduated from University of
25 Connecticut with your Ph.D., what hydrology related jobs

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1 have you worked on, generally speaking?

2 A. Oh, since then I've been working with Stone
3 & Webster Engineer Corporation in Boston. Over the
4 years I involve a lot of the project. In the early day,
5 in the '70, '80, mostly in the nuclear project area,
6 which I participate in my amended report including
7 hydrology area, modeling of groundwater. And give you
8 an example, in the Millstone 3 Nuclear Power Station
9 there's one study which I participate is, what happen if
10 a tank rupture in the building area, and then a scenario
11 that hit the ground and the groundwater, how that will
12 disperse into the nearest water body.

13 And over the years, other nuclear power
14 station also involved, too, like the Shorehan project,
15 Nine Mile 2. And some other, even the fossil plant.
16 Most recent three, four years I'm involved a lot with
17 the siting study of the fossil plant which all involve
18 hydrology -- what happens if a storm come in to runoff,
19 how are we going to control the water quality of the
20 storm runoff before it leaves, and so on.

21 Q. So are you involved in siting monitoring
22 wells and production wells, things like that?

23 A. Not really, but at one point we -- Stone &
24 Webster is very diverse company. Not only in the power
25 plant, we also have environmental cleanup. Sometimes

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1 because so many projects going on, they want some
2 personal resource. I was asked a number of times to
3 look into this so-called monitoring well. Ground
4 well -- at the groundwater well, there was monitoring,
5 and then give some technical input to the specification
6 and so on.

7 Q. Do you usually look at -- you don't put in
8 the well, or put in the wells yourself --

9 A. No.

10 Q. -- but you look at the well logs?

11 A. No.

12 Q. You don't look at the well logs?

13 A. Oh, yeah, I review well log. I have some
14 there that come in. I do -- I did.

15 Q. Okay. And so you're experienced in well
16 logs, well construction, and pump tests, or other types
17 of aquifer tests?

18 A. Yes, I involved in -- when I worked with the
19 Stone Webster, yeah. As a matter of fact, I -- most, on
20 this one I also give some supervision to the engineer
21 under me to prepare that kind of spec, like scope of
22 survey and so on.

23 Q. There is a pump test, a test well in this
24 matter that was installed at the site?

25 A. Yes.

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1 Q. And a pump test was done -- or I shouldn't
2 say a pump test. Actually it was a static level test --

3 A. Right.

4 Q. -- that was performed on the site. Are you
5 familiar with that well?

6 A. I reviewed the result. But the actual
7 supervision of that pump test is under my coworkers at
8 Stone Webster.

9 Q. Do you consider yourself an expert in test
10 well analysis? Is this an area of your expertise that
11 you would -- assuming the data came to you that you
12 could look at it and give an expert opinion on test data
13 from a well?

14 A. Yes, I consider myself in that -- if it have
15 something, data in -- show me, I review it, yeah.

16 Q. Are you familiar with different types of
17 geologic formations?

18 A. Geologic formation area is not my area,
19 because that -- in Stone Webster we have another group
20 of people, geotechnical group. They will do a lot of
21 geological investigation, study, collect data and so on.

22 Q. For purposes of Contention 0, subsurface
23 hydrology, would you consider yourself an expert, then,
24 in which types of formations would produce water in
25 amounts that would be useful to PFS on the site?

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1 A. I'm not in that area, no.
2 Q. Surface water modeling?
3 A. Yes.
4 Q. Do you do surface water modeling?
5 A. A lot.
6 Q. Okay. That would be --
7 A. But I have to qualify here, because
8 sometimes if our project required -- I mean, we still --
9 not the latest project. We will formulate our Stone
10 Webster model, but sometimes we using federal government
11 ready available model, surface model and render modeling
12 using.
13 Q. But you consider yourself an expert --
14 A. Oh, yeah.
15 Q. -- in the operation of those government
16 models?
17 A. Oh, yeah.
18 Q. Okay. Were you involved in preparing or
19 supervising the environmental report for PFS in this
20 matter?
21 A. On section, surface hydrology section, yes,
22 in the amended report and Safety Analysis Report.
23 Q. You also helped prepare or supervise the
24 Safety Analysis Report?
25 A. Hydrology section.

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1 Q. Hydrology section?
2 A. Yeah.
3 Q. Are you familiar with Contention 0?
4 A. Yes.
5 Q. And Contention 0 has many aspects to it
6 regarding environmental impacts. Are you familiar with
7 the environmental impacts analysis that PFS performed?
8 A. Yeah.
9 Q. What I want to do next is put some
10 boundaries on where you are an expert in this matter.
11 From what you've told me, sounds like you are an expert
12 on surface water modeling.
13 A. Uh-huh.
14 Q. Is that correct?
15 A. Uh-huh.
16 Q. You are an expert in groundwater modeling?
17 A. Yes. As a matter of fact, I wrote an
18 article on that and presented in a symposium. That in
19 my resume on the publication. On the groundwater model
20 to use remediation of hazardous waste site, compare
21 different model.
22 Q. What about areas of environmental impact as
23 far as degradation of surface or groundwater quality?
24 A. What do you mean by that, degradation?
25 Q. Adversely affecting the water quality of

1 groundwater or surface water.
2 A. Yeah. As a matter of fact, this is one of
3 the -- when we prepare project report, no matter if it
4 is nuclear or fossil, within Stone Webster scope of
5 work, usually after modeling the ultimate goal is to
6 evaluate what the impact in the environment, because
7 this is always required by federal regulation or NRC
8 guidelines to prepare ER. So modeling is the first step
9 to prepare, but the evaluation impact is the ultimate
10 objective.
11 Q. Let me continue on that vein. When PFS
12 decided to go out and study the potential environment
13 impacts from its proposed facility, what is the general
14 format for doing it? Is it structure? Does it scope
15 out a whole universe of potential environmental impacts
16 and then decide to go out and collect data on each of
17 those? Or does it take some other approach? You
18 mentioned that modeling was the first step in the
19 process. Isn't there -- are there other steps prior to
20 modeling? How do you decide what it is to model?
21 A. Let me answer your question. First, when I
22 say those step is not saying that -- of course, you also
23 have to go to the PFS project. But answer your
24 question, say, specific for this, I was bring on board
25 before that process, so those consideration, the

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1 boundary to this and how it is determined, I did not
2 participate in that decision for this project, Private
3 Fuel Storage project.
4 Q. So if I understand your answer correctly,
5 the initial scoping as to potential environmental
6 impacts from this project was not something you were
7 involved with?
8 A. Yes.
9 Q. Okay. What areas -- what specific
10 environmental impacts were you involved in analyzing?
11 A. For this project?
12 Q. For this project.
13 A. I was brought on board when the question
14 from NRC about the PMF, which also the state have some
15 contention on that subject, PMF.
16 Q. I'm sorry. What did you say after that? I
17 just didn't hear you.
18 A. Oh. I was brought on board to work on this
19 project when we received NRC question on the PMF on the
20 Private Fuel Storage site.
21 Q. Were you involved in any analysis as far as
22 determining contaminant pathways from the applicant's
23 sewer or wastewater system?
24 A. Will you repeat the question?
25 Q. Were you involved in analyzing any potential

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1 environmental effects from the applicant's sewer or
2 wastewater system?

3 A. Not analyzing, no.

4 Q. How would you portray your involvement in
5 that?

6 A. I was involved when they -- when we received
7 the question on the contaminant pathway, then I reviewed
8 the ER, SAR to that subject, what the environmental
9 impact would be.

10 Q. So your involvement in that analysis was
11 reviewing existing documents that had been prepared by
12 someone else?

13 A. Yes.

14 Q. Is that true as well for Utah's contention
15 regarding contaminant pathways from PFS's retention
16 pond?

17 A. Yes.

18 Q. You reviewed existing documents regarding
19 that, but you did not actually help prepare those
20 underlying documents?

21 A. Yes.

22 Q. Is that true as well for Utah's Contention 0
23 regarding potential for groundwater and surface water
24 contamination?

25 A. Yes.

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1 Q. Is that true as well for Utah's Contention 0
2 regarding effects of applicant's water usage on other
3 well users and on the aquifer?

4 A. Yes.

5 Q. And that's true as well for Utah's
6 Contention 0 regarding impact of potential groundwater
7 contamination on downgrading hydrological resources?

8 A. Yes.

9 Q. So if I understand correctly, your expert
10 testimony today on Utah's Contention 0 would be based
11 upon data and information provided in reports which you
12 didn't prepare or supervise?

13 MR. GAUKLER: Objection. You may go ahead
14 and answer the question. The objection is unclear. I
15 don't think he testified to that, so...

16 MR. SEEL: Okay. I'm trying to find out
17 what it is that he can testify to today, and my
18 understanding is he's relying on documents that he
19 didn't help prepare but merely reviewed.

20 Q. (BY MR. SEEL) Mr. Liang, I'm trying to put
21 some boundaries on what it is you know and what you've
22 done so we can figure out where you're an expert and we
23 can expect you to provide expert testimony, and where
24 you're not an expert and you won't be providing expert
25 testimony on this matter.

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1 Did you help prepare the environmental
2 report in this matter?

3 A. I need to -- specifically what area?

4 Environmental covers so many section, so many area.

5 And your question say, do I have to prepare my own
6 report. I cannot answer. All I can only answer, say I
7 prepare hydrology section of the environmental report.

8 Q. So you helped prepare the hydrologic section
9 of the ER?

10 A. Yes.

11 Q. Did you rely on other documents or other
12 information to prepare that section of the ER?

13 A. We used reference, and based on the scope of
14 what required on the ER, which has NRC Reg guideline, we
15 started to provide input data from the site or from
16 existing literature, and then we decide which model to
17 use. And then after running these all number required
18 by -- all the information resulting, required by the
19 NRC, we prepared the section.

20 Q. When you were preparing that section of the
21 ER, were you doing it to comply with the NRC regulation?

22 A. Yes.

23 Q. Was that NRC regulation --

24 A. 4.2, Reg Guide 4.2, Environmental Report.

25 That's the reg guide guideline give you what should be

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1 included in that hydrology section or other section.
2 Very detailed, what you should be use and so on. Reg
3 Guide 4.2 of NRC for all nuclear facility.

4 Q. In PFS's, Applicant's Responses to Requests
5 for Admissions No. 119 of Contention 0, PFS has taken
6 the position, it appears, that there was a lack of a
7 direct hydrological link between groundwater and the
8 surface at the PFS site. Are you familiar with that
9 position?

10 A. Yes.

11 Q. PFS's position that there is a lack of a
12 direct hydrologic link between groundwater and the
13 surface?

14 A. Yes, I'm familiar with that.

15 Q. Are you able as an expert opinion to respond
16 and answer questions regarding that issue?

17 A. Yes.

18 Q. Can you please explain in general terms how
19 PFS reached the conclusion that there was no direct
20 hydrologic link?

21 A. At the site?

22 Q. At the proposed site.

23 A. Yeah. The reason for that is, we -- during
24 the preparation year we did an evaluation and survey,
25 and we haven't found, or only few perennial stream, but

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1 very -- none at the site.

2 And also we did some soil investigation by
3 geotechnical group and found out that mostly is silt or
4 clay or silty clay. Because there's no surface water at
5 the site, there's hardly any interconnection between --
6 the link between these two, the surface water and
7 groundwater area. That's my conclusion.

8 Q. So as I understand your answer, your
9 conclusions or your expert opinions on that are based on
10 two things: low amounts of precipitation and the
11 permeability of the soils at the site?

12 A. Yeah.

13 Q. Is there any other factors that might have
14 gone into that decision?

15 A. Also we think the five-mile radius of the
16 site. We haven't found any permanent water body. The
17 only thing we have found is more reservoir or pond for
18 the irrigation purpose.

19 Q. We're talking about a hydrologic connection
20 between the surface --

21 A. And the groundwater.

22 Q. -- and the groundwater?

23 A. Right.

24 Q. Is depth to groundwater a factor that went
25 into your --

1 that permeability is -- I remember is .142 feet per day.

2 Q. Is that the permeability of the surface
3 soil, or is that the permeability of the soil in the
4 screened area of the well?

5 A. At the screened area of the area, yeah.

6 Q. And I understand that PFS is proposing to
7 use a well or series of wells to obtain water for under
8 the site?

9 A. Yes, that's what I understand.

10 Q. And that this 0.142 -- was it feet per day?

11 A. Uh-huh.

12 Q. -- permeability is sufficient to provide
13 water to the site?

14 A. Without calculation I cannot answer your
15 question.

16 Q. I'm sorry?

17 A. Without calculation.

18 Q. Well, I guess -- would you consider that
19 permeable enough to water that you would consider using
20 it as a production well?

21 A. I believe so. But I want to add to it: also
22 depend on how much water you're going to pump from the
23 well. They are related.

24 Q. So the permeability that we were discussing
25 is at the base of the test well CBT-5?

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1 A. Yes.

2 Q. -- conclusion?

3 A. Yes.

4 Q. Okay. There was factors: depth to ground
5 water, the permeability of the soils, and the amount of
6 precipitation at the site?

7 A. Yes.

8 Q. Based on those three factors, you came to
9 the conclusion that there was no direct hydrological
10 link?

11 A. Yes.

12 Q. To use those factors, I assume you had to
13 collect some data of some kind on those three factors?

14 A. Yes.

15 Q. Okay. Could you please explain to me the
16 data that was collected regarding the permeability of
17 the soils?

18 A. The permeability of soil, we have a monitor
19 well, CBT No. 5, which we install a casing two inches,
20 become a monitoring well. The reason that this spot is
21 a boring hole, but later on we decide to install a
22 monitoring well, two-inch diameter. And our geology --
23 geotechnical group do a so-called constant head pumping
24 test, and then after the data collected, the
25 geotechnical engineers have a calculation, calculated

1 A. Uh-huh.

2 Q. It's not the permeability of the surface
3 soils. Is that my understanding?

4 A. True.

5 Q. And my understanding, getting back to these
6 three factors, is that the permeability of the surface
7 soils or the permeability of the soils under the site
8 will prevent downward migration of surface waters?

9 A. Uh-huh.

10 Q. I have a figure here entitled Figure 2.6-23,
11 entitled Canister Transfer Building Foundation Profile
12 3-3, looking east. It is from the Safety Analysis
13 Report. Would you please take a look at that.

14 A. Yeah, uh-huh.

15 Q. Do you recognize that document?

16 A. Yes, I have seen the figures.

17 Q. Would you please describe to me the
18 formations on there that you believe were going to
19 prevent downward migration of surface waters?

20 A. Oh, that's easy, because on the clay, as we
21 present in the SAR and ER and also in the Safety
22 Evaluation Report prepared by NRC, saying in the Skull
23 Valley the silt permeability is .2 to .6 inch per hour.
24 That's on Safety Evaluation Report page 2-23. But this
25 number was developed by U.S. Department of Agriculture.

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1 They analyze the soil at the Skull Valley.

2 On the categories, this so-called soil group
3 classification is clay, silty clay and so on. That
4 permeability, in my expert opinion, is very, very low.

5 Q. And that was in the Safety Analysis Report?

6 A. Page 2-23, prepared by NRC. Also presented
7 in our -- I believe in ER.

8 Q. What was the permeability in the screened
9 area of the test well?

10 A. Is .142 feet per day.

11 Q. And the permeability of the surface soils
12 were -- I believe you said 0.2 to 0.6 inches per hour?

13 A. .2 to .6 inch per hour.

14 Q. How do those two permeabilities compare to
15 each other?

16 A. That is the soil test result. The other one
17 is, if you -- someone make the unit the same, then you
18 can compare. I haven't done that.

19 Q. It's just a conversion of units?

20 A. Right.

21 Q. Could you do the conversion for me?

22 A. Yeah. I need a pen and paper.

23 So the clay permeability is from .4 feet per
24 day to 1.2 feet per day, the permeability of clay, in
25 comparison with .142 feet per day at 120 feet down.

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22

1 It's a range. The clay permeability had a range from .4
2 feet to 1.2 feet per day. That's my calculation.

3 Q. The clay ranges between 0.44 feet per day
4 and 1 foot per day?

5 A. 1.2.

6 Q. 1.2. Having done the conversion, is there a
7 significant difference between your calculation of the
8 permeability of the surface soils and the permeability
9 of the soils at the bottom of the test well?

10 A. I didn't get you at first. Will you repeat
11 the question?

12 Q. Is there a significant difference in the
13 permeability?

14 A. No. In my engineering, we say this the same
15 magnitude order.

16 Q. So the soils from which PFS is intending to
17 acquire water is just as permeable or impermeable,
18 depending on how you look at it, as the soils which are
19 going to prevent downward migration of surface water?

20 A. I won't say that. You see, the production
21 of the water, not only when you heat the aquifer, is not
22 only depend permeability. They are also when so-called
23 transmittability. Because permeability is this way, the
24 transmittability is from horizontal. There's two
25 coefficient in there.

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23

1 Q. So this is a heterogeneity in the aquifers?

2 The permeability in the three dimensions differs?

3 A. No. The permeability is vertical, the
4 transmittability horizontal, coefficient. An aquifer
5 is -- how much water you can do is not only
6 permeability. You have other coefficient also affect
7 the production of the well is the transmittability
8 coefficient.

9 Q. Are you saying the permeability of the
10 surface soils --

11 A. Uh-huh.

12 Q. -- does not determine the ability of it to
13 transmit water?

14 A. I didn't say that.

15 Q. Well, let me ask this question, then. What
16 is the difference between permeability and hydraulic
17 conductivity?

18 A. I don't know that.

19 Q. Are you familiar with the term "hydraulic
20 conductivity"?

21 A. I would say no.

22 Q. I have a document here which is page 5 of
23 Stone and Webster Engineering Corporation calculation
24 sheet entitled Determination of Aquifer Permeability
25 from Constant Head Test, an Estimation of Radius

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1 Influence for the Proposed Water Well.

2 A. Uh-huh.

3 Q. I'd like you to take a look at it and see if
4 you're familiar with that.

5 MR. GAUKLER: Could you show him the
6 calculation, please. And also I'd like to have the
7 revision of the data and calculations stated for the
8 record.

9 For the record, it's revision zero, the
10 calculation dated April 22nd, 1999.

11 A. Yeah.

12 Q. Mr. Gaukler has raised a good point. I
13 understand that there was a newer revised version part
14 of this document, which we received yesterday.

15 Here's a revised version of the same
16 document. There's a page 5. Could you look at that as
17 well and confirm your testimony?

18 A. Same page?

19 Q. Page 5, yes.

20 MR. GAUKLER: This is Revision 2, dated
21 March 27, 2001.

22 A. You only want me to look at page 5?

23 MR. GAUKLER: If you need to look at the
24 entire document, please do so.

25 THE WITNESS: Page 5, yeah.

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1 Q. (BY MR. SEEL) There's a symbol on there
2 identified as K.
3 A. Yeah.
4 Q. What is the --
5 A. The K is permeability, meter per second.
6 Q. What are the units associated with the K?
7 A. The unit? I said meters per second.
8 Q. Are those the correct units for
9 permeability?
10 A. I believe so.
11 Q. I have an introductory groundwater textbook
12 by the name of Freeze and Cherry. I'd like you to take
13 a look at page 29.
14 A. Page 29.
15 Q. At the bottom there's two parameters --
16 sorry. Look at page 30 -- 29.
17 A. Twenty-nine.
18 Q. Two parameters, one identified as
19 permeability and one as hydraulic conductivity.
20 A. Uh-huh.
21 Q. What are the units associated with the
22 permeability?
23 MR. GAUKLER: Use as much of the document,
24 the book, as you need to.
25 THE WITNESS: Yeah.

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1 A. Okay, I'm finished.
2 Q. What are the units associated with the
3 parameter of permeability?
4 A. The table did not show that. The table only
5 show you from one unit how to convert to the other unit.
6 There's a different way to express a unit. But this is
7 so-called conversion factor for permeability. It is not
8 the unit for permeability. So you have a unit, he show
9 this table. If you have foot per second, how to convert
10 to feet per second and so on.
11 Q. Why would the units change between the
12 conversion? Why would the units between permeability
13 and hydraulic conductivity be different?
14 A. Hydraulic conductivity, meter per second and
15 then converted feet per second.
16 Q. But the units are the same. We simply have
17 changed the system of units.
18 A. Correct, yeah.
19 Q. We've gone from metric to English.
20 A. To -- metric to English.
21 Q. Let's take a different approach. Is
22 permeability, the units of permeability always length
23 over -- excuse me. Are the units for permeability
24 always length squared? It doesn't matter what unit or
25 what type of system you're in, it's always going to be a

1 length squared?
2 A. Yes.
3 Q. And for hydraulic conductivity, will the
4 units always be length over --
5 A. Length over time.
6 Q. -- time?
7 A. Per second. Yup.
8 Q. Getting back to page 5 of the Stone &
9 Webster document.
10 A. Uh-huh.
11 Q. What are the units on permeability?
12 A. Liter per second.
13 Q. Are those the correct units for
14 permeability?
15 A. There is a difference in the textbook and
16 the calculation. The unit differs. But we can check
17 back on the reference weighted formula or reason it
18 from, because there's a reference for this formula, and
19 I believe the formula also define the way, what units
20 should be used in that formula.
21 Q. The question is, do we have a reference?
22 A. I would like to have a moment.
23 Q. Take your time.
24 A. According to this formula, permeability is
25 expressed in meter per second. I analyzed this formula

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1 by the unit of individual turn. L is lengths of the
2 permeability test section in meter, and then Q is the
3 water flow rate into the well, liter per minute. And
4 then H is height of the water above static equilibrium
5 level in meters.
6 I just operate the unit and come out --
7 after I all cancelled this, it came out as length over
8 time.
9 Q. So it's really not permeability at all, it's
10 hydraulic conductivity?
11 MR. GAUKLER: Objection. He didn't say
12 that.
13 Q. I'd like to get back to the three factors
14 that you relied upon to come to the conclusion that the
15 surface soils at the site would prevent the downward
16 migration of surface waters into the aquifer. There
17 were three factors.
18 A. At the site, yeah.
19 Q. Correct me if I'm wrong. Those three
20 factors were depth to the water, the groundwater, the
21 low permeability of the soils at the surface, and low
22 amounts of precipitation?
23 A. Will you repeat? I didn't follow.
24 Q. I understood there were three factors.
25 A. Yes.

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1 Q. The first being depth to groundwater --
2 A. Uh-huh.
3 Q. -- the low permeability of soils at the
4 surface --
5 A. Yeah.
6 Q. -- and low amounts of precipitation.
7 A. Yes.
8 Q. This is from a document I believe you've
9 already looked at. This is page 3.
10 A. Yes. This is an attachment to the
11 calculation.
12 Q. And this is well construction log for the
13 test well?
14 A. Okay.
15 Q. My understanding from looking at the log --
16 is that, at the bottom of the borehole --
17 A. Uh-huh.
18 Q. -- a sandy silt or silty --
19 A. Silty sand.
20 Q. Silty sand?
21 A. Uh-huh.
22 Q. And that was where you were going to be
23 acquiring water for your pump well when it was
24 installed?
25 A. Normally we extract water when we heat this

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1 water coming out, heat a depth which we have water
2 pumping out. It could be some other location change,
3 maybe deeper or shallower. But at that spot, yes, we
4 will have a silty sand and we heat the water.
5 Q. This area here, is this sand in the
6 construction log?
7 A. Yes.
8 Q. Is that not from the surrounding formation?
9 A. No. We put it when we install the well.
10 Q. And then there's this layer here?
11 A. Uh-huh.
12 Q. What's that say?
13 A. 125.5 to 122 elevation we put some
14 bentonite, b-e-n-t-o-n-i-t-e, pellet, p-e-l-l-e-t, seal.
15 Q. So the bentonite isn't part of the
16 surrounding formation?
17 A. No.
18 Q. Why did you put it in?
19 A. Because you have to seal the well, prevent
20 the water coming in the side, which is a --
21 circumference is circular.
22 Q. It's to prevent water from coming up the
23 well?
24 A. Uh-huh. No, no -- yeah, coming up it.
25 Not -- we pump from here, but we don't want the water --

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1 without filter, because the sand is acting as a filter
2 action, we don't want the water to come out and then
3 become unfiltered. This sand is prevent this water
4 coming out on the side way. We're actually pumping the
5 water from here.
6 Q. And this is -- up here, this is cement?
7 A. Yes.
8 Q. And this is to prevent groundwater from
9 coming up to the surface, not to prevent surface water
10 from going down into the well?
11 A. Yeah, Yes. Actually, there's two way. We
12 don't want surface water to -- we don't know what
13 surface quality will be. Actually, it's a two way. We
14 prevent the surface water because we don't want it to
15 come down there. And we don't want the groundwater
16 coming up the side way, you know, which will be --
17 affect our pumping from here.
18 Q. So the bentonite seal and cement bentonite
19 placed around the well --
20 A. Yes.
21 Q. -- is to prevent water from the surface
22 migrating down, and water from the subsurface --
23 A. Going up.
24 Q. -- going up. And that's to preserve the
25 water quality?

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1 A. That's one of the reasons, uh-huh. I look
2 at that very carefully. And they were confirmed through
3 a Driscoll, author by Driscoll, Groundwater Handbook,
4 the construction of the well.
5 Q. The construction of the well was to --
6 A. Is very -- follow the guideline according to
7 the book of Driscoll, Groundwater Handbook. Put the
8 sand and then sealed it by cement and so on.
9 Q. If they had not put in the seal, would this
10 have punctured this zone of surface silt and clays that
11 PFS asserts will prevent downward migration?
12 MR. GAUKLER: Objection. What would
13 puncture it? It's not defined.
14 Q. (BY MR. SEEL) The borehole in which the
15 well is installed.
16 A. Uh-huh.
17 Q. It would have punctured that -- step back.
18 If they had not put the seal in place around this well,
19 would it have provided a pathway for surface waters to
20 migrate into the aquifer?
21 A. I don't understand your question.
22 Q. What is the purpose behind putting the
23 bentonite and cement bentonite seal in the well?
24 MR. GAUKLER: Asked and answered. You may
25 answer it again.

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1 A. I already answered. The reason, because we
2 don't want the groundwater coming on the side way,
3 rather than we like water coming up from the well casing
4 itself. That's the reason.

5 Q. If the bentonite seal and the cement
6 bentonite portion of the well was not there, could
7 surface waters migrate down into the aquifer?

8 A. No.

9 Q. If the question is not clear --

10 A. No, no, surface water would not migrate. If
11 you don't have this sand or the bentonite over there,
12 the surface water will not migrate, no.

13 Q. Surface waters would not migrate down
14 through this area?

15 A. Uh-huh.

16 Q. Why not?

17 A. Because there's soil surrounding it.

18 Q. So why bother to put in a bentonite seal at
19 all?

20 A. Because, as I say earlier, it prevent the
21 water coming up from the side way, not from the casing,
22 the well casing itself.

23 As I say earlier, the bentonite pellet also
24 let the water stay down so they can go into the --
25 through the wells the sand have the filter effect, so it

1 A. Uh-huh. After they present in the ER.

2 Q. Were you involved at all in the drilling of
3 these boreholes?

4 A. No. A colleague.

5 Q. Your --

6 A. My colleague at Stone Webster.

7 Q. Colleague?

8 A. Yeah, my co-worker.

9 Q. Approximately how many boreholes are located
10 on that map?

11 A. Based on the symbol -- one, two, three,
12 four; one, two, three, four, five. Four times five is
13 twenty.

14 Q. Do you know what the diameter of those
15 boreholes were?

16 A. If my memory right, it's about two inches.
17 I may be wrong. Or one inch.

18 Q. I'll show you another document entitled
19 Boring Log.

20 A. Okay, yeah.

21 Q. Boring B-1.

22 A. Uh-huh.

23 Q. Stone & Webster Engineering Corporation,
24 Sheet 1 of 2, dated 8/31/99.

25 A. Uh-huh.

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1 keep the water you pump in from the casing clear. You
2 don't want some sediment or something to come up when
3 you pump the water. This practice also for any
4 residential when you have your own water well supply
5 from your backyard.

6 MR. GAUKLER: We've been more than an hour.
7 Can we break?

8 MR. SEEL: Why don't we take a break.

9 (Recess from 10:25 to 10:41 a.m.)

10 Q. (BY MR. SEEL) Mr. Liang, I'd like to return
11 to the three factors that PFS relied upon to reach its
12 conclusion that surface soil at the site will prevent
13 the downward migration of surface waters.

14 I have a document here entitled Figure
15 2.6-2, Plot Plan and Location of Geotechnical
16 Investigations, Sheet 1 of 2 from the Safety Analysis
17 Report, Revision 8. Would you take a look at it,
18 please.

19 A. Okay.

20 Q. There are a number of borehole locations
21 identified on that document.

22 A. The symbols say "boring location," yes.

23 Q. Are you familiar with this document?

24 A. I reviewed the document.

25 Q. You reviewed this document?

1 Q. Please take a look at that.

2 A. Okay.

3 Q. In the area identified as methods.

4 A. Uh-huh. You mean the boring log, yeah.
5 Methods.

6 Q. Methods. It should identify the --
7 actually, would you read that section?

8 A. Drilling soil: 3-1/4 inch inside diameter
9 hollow stem augers. Sampling soil: Two-inch outside
10 diameter split spoon, 24 inches long, 3-inch outside
11 diameter Shelby sampler, S-h-e-l-b-y sampler, 30 inch
12 long. Drilling: Rock.

13 Q. Thank you. Where it says "3-1/4 inch inside
14 diameter hollow stem augers," does that mean the auger
15 was 3-1/4 inches in diameter?

16 A. As I understand it, something like this, and
17 then inside diameter means this.

18 Q. Inside the hollow stem?

19 A. Uh-huh.

20 Q. So inside the hollow stem is 3-1/4 inches in
21 diameter?

22 A. Inside diameter.

23 Q. So the outside diameter of the auger itself
24 would be more than 3-1/4 inches?

25 A. True.

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1 Q. So the borehole was at least 3-1/4 inches?
2 A. During the drilling, yes.
3 Q. It would have been at least 3-1/4 inches
4 diameter?
5 A. Yes.
6 Q. Would you read the comment section of that
7 document?
8 A. "No groundwater or bedrock encountered.
9 Backfilled to ground surface with soil, marked with
10 stake."
11 Q. Do you know why they didn't backfill these
12 boreholes with something other than soil?
13 A. I don't know. However, based on my expert
14 opinion, why fill with something else?
15 Q. Well, when PFS drilled their well, they
16 backfilled with a cement bentonite mixture and a
17 bentonite seal.
18 A. That is because for different purpose.
19 Q. My understanding is PFS has taken the
20 position that the surface soils are permeable enough to
21 prevent the downward migration of surface waters to the
22 aquifer. Is that correct?
23 MR. GAUKLER: Asked and answered. You may
24 answer it again.
25 A. I don't understand. You say pick a

1 those are coming on the side way. After that you fill
2 that, yes.
3 Q. Disrupting those soils when they were
4 drilled wouldn't affect their permeability?
5 A. Your question pretty general, because we are
6 doing something on one spot. I don't know that we're
7 going to change. On that hole itself, I would say it
8 could.
9 Q. When soils are placed back into a borehole,
10 are you familiar with how that process takes place?
11 A. That's a common practice. I don't know the
12 detail of the process.
13 Q. Do you know whether the geologist on the rig
14 is the one who fills in the borehole?
15 A. No.
16 Q. The driller? The driller's helper?
17 A. I cannot answer this question, because we
18 have a -- I have a co-worker. He was at the operation
19 when the driller drilled this thing, make sure
20 everything follow the rule procedure or the scope of
21 survey we developed, Stone Webster.
22 Q. Do you know whether they placed the soils
23 back into the hole and compressed them so that they were
24 the same density as the surrounding soils?
25 A. No, I don't know this.

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1 position. Will you clarify what that means?
2 Q. PFS has concluded that the surface soils are
3 impermeable enough to prevent the migration of surface
4 waters to the aquifer.
5 A. With this in the ER or SAR, I forgot, we'd
6 say is very little chance to infiltrate into the ground
7 from the surface water.
8 Q. What if there were holes punctured in that
9 surface layer? Would those holes act as a pathway for
10 surface waters to migrate to the aquifer?
11 A. I need some definition of puncture. Because
12 if I say you have a membrane or some soil, then puncture
13 I understand. When you have a soil, I don't know how
14 you define a puncture.
15 Q. A borehole of a minimum diameter of 3-1/4
16 inches.
17 A. If you have a hole in the ground, clear, no
18 obstruction on that hole, you say pathway, I will agree
19 this.
20 Q. In your expert opinion, would backfilling
21 the boreholes with soil sufficiently seal that zone so
22 they could not act as a pathway for surface waters?
23 A. Yes, because that soil is pretty much what
24 was coming out in the drilling operation. As a result,
25 those soils just, you know, because you have a hole, so

1 Q. Do you know whether they just shoveled the
2 dirt back in?
3 A. No, because I was not there.
4 Q. If the soils weren't placed back in the hole
5 and compressed to the same density as the surrounding
6 materials, would that change the permeability of those
7 soils within the borehole?
8 A. In my expert opinion, no. If they compact,
9 put back the soil which originally come from the hole, I
10 don't think it will change the permeability. That's
11 only my own expert opinion.
12 Q. Do you know why the state well drilling
13 regulations require cement or bentonite placed into
14 boreholes instead of just soil cuttings?
15 A. No, I don't.
16 Q. Do you know if the original field logs that
17 were taken by the person who logged the hole would
18 indicate how they backfilled those boreholes?
19 A. I reviewed a couple of the bore logs
20 specifically to ER, CBT No. 5. I didn't read any they
21 described the method to backfill back to the borehole.
22 Q. Are there boring logs that were handwritten
23 in the field from which this boring log was generated?
24 A. I know if a technical -- I mean, a
25 geotechnical engineer supervised this, he himself would

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1 make some field note. And later on after contract
2 completed, he would probably generate log, and then if
3 any discrepancy he will fill in.

4 Q. But the field logs exist, as far as you
5 know, for these boreholes, the original field logs?

6 MR. GAUKLER: Objection on what you mean by
7 "original."

8 MR. SEEL: Handwritten. Unless the driller
9 or the geologist on site somehow through a computer
10 generated that document right there, there must be some
11 underlying documents from which that document is
12 derived.

13 MR. GAUKLER: Is that a question?

14 Q. (BY MR. SEEL) In your opinion, do people in
15 the field collect raw data that they write down in a
16 field notebook?

17 A. This is my understanding. This is general
18 engineering practice.

19 Q. And it's from those field notebooks that
20 this boring log was derived?

21 MR. GAUKLER: If you know.

22 A. I believe so.

23 Q. Do you know if those field logs have been
24 disclosed to the State of Utah?

25 A. Not to my knowledge. I don't know anything

1 A. That is area I'm not in a position to
2 answer, because that is design the sewer engineer would
3 know.

4 Q. Were you asked to give PFS -- strike that.
5 PFS intends to use water from at least one source
6 through the construction and operation of this proposed
7 facility. Is that correct?

8 MR. GAUKLER: Object as vague and ambiguous.

9 Q. Does PFS need water to construct its site?

10 A. Yes.

11 Q. Has PFS proposed where it intends to obtain
12 that water?

13 A. Will you ask this question again?

14 Q. Has PFS proposed a source for the water it
15 intends to use to construct the site?

16 A. Yes.

17 Q. Were you responsible for determining the
18 potential environmental effects from using the water
19 from that source or sources?

20 A. No. But I reviewed the section which
21 provided by my company colleague.

22 Q. Are you able to give an expert opinion as to
23 the environmental effects associated with using the
24 water at the site?

25 MR. GAUKLER: Object. It's unclear when you

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1 about this.

2 Q. My understanding is that PFS intends to
3 install at least one sewer system or disposal system of
4 some kind on the site. Is that correct?

5 A. I think -- I'm not in that area, but my
6 colleague which is in Denver engineered and designed the
7 sewer system. So I don't think I am in the position to
8 answer your question.

9 Q. Are you familiar that the sewer system will
10 involve liquid disposal to the subsurface?

11 A. I know the sewer system in general, how it
12 works, yeah.

13 Q. Is your colleague Mr. Lewis?

14 A. Wayne Lewis.

15 Q. He's the individual who would be familiar
16 with the design and operation of the system?

17 A. Is in my belief, yes.

18 Q. Would he also be familiar with the ultimate
19 fate of the fluids that are going to be put down in that
20 system? Or would that be the area that you would be
21 familiar with?

22 MR. GAUKLER: Objection. What do you mean
23 by ultimate fate? Unclear and ambiguous.

24 Q. Where is the water that's going down the
25 sewer system going to end up?

1 say using the water at the site, the environmental
2 effects of. Are you talking from environmental effects
3 of water use at the site in terms of water being used in
4 the construction process, or water being obtained,
5 environmental effects of water being obtained from some
6 source, i.e., the well?

7 Q. What are the potential sources of water that
8 PFS is proposing?

9 A. As I read the ER, they proposed either on
10 site, if they found available quantity of groundwater,
11 or they would truck in from outside source, or for some
12 aspect of the need they would bring in some bottled
13 water.

14 Q. To determine a potential environmental
15 effect on a source of water, do you need to know where
16 that source is?

17 MR. GAUKLER: Objection, vague and ambiguous
18 question.

19 Q. Can you identify for me the exact location
20 of the off-site sources?

21 A. No, because I'm not involved the original
22 proposal where to get these waters' source outside.

23 Q. Do you agree that you need to know what the
24 source of the water will be before you can take the next
25 step and analyze what the potential environmental

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1 effects may be to that source?

2 MR. GAUKLER: Objection, vague and ambiguous
3 question. You may answer if you can.

4 A. You have to repeat the question because I
5 don't know if you're talking about outside the --
6 outside the site or on site or both.

7 Q. Precisely. How can you determine the
8 environmental effects for using water from the source if
9 you don't know where that source is?

10 MR. GAUKLER: Objection, ambiguous.

11 A. I remember ER section have addressed what
12 your question is, but I can't remember exactly where the
13 section or which chapter regarding your question about
14 identify the source of the water come from. And they
15 addressed what kind of impact would be and so on. It's
16 already been addressed in the ER, which I don't know
17 which section it is, because I originally did not
18 participate about this proposal or calculation of how
19 much water used during different phase of the PFS
20 project into construction operation phase.

21 Q. So you believe the environmental report
22 looks at each potential source of water for this
23 facility and analyzes --

24 A. Address the impact.

25 Q. Analyzing the environmental impact for each

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1 of those --

2 A. Address the impact, yes.

3 Q. -- sources?

4 A. I remember I have read the section, but I
5 can't remember exactly which section. Or during the
6 phase of answer in RAI, NRC request for additional
7 information, I remember. But I don't know which
8 specific question. But this issue had been addressed
9 and answered either in the ER or in the response to NRC
10 RAI about the water source, where it come from, what the
11 impact would be if we choose that way.

12 Q. Has PFS determined what the aquifer is under
13 the site?

14 MR. GAUKLER: Objection, vague and
15 ambiguous. Answer if you can.

16 A. You mean the aquifer of what? Where the
17 aquifer is?

18 Q. Has PFS determined what constitutes the
19 aquifer under the site?

20 A. I still don't understand your question:
21 constitute aquifer.

22 Q. I show you a document.

23 A. Okay.

24 Q. It is from NUREG-1567, Section 2, page 2-12,
25 subsection 2.4.5 entitled Subsurface Hydrology.

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1 A. Uh-huh.

2 Q. Would you please read that section for me?

3 A. Paragraph 2?

4 MR. GAUKLER: Please show him more of the
5 document, please. What NUREG number is that, did you
6 say?

7 MR. SEEL: 1567.

8 THE WITNESS: Second paragraph. Under the
9 section --

10 MR. GAUKLER: We'll get you more of the
11 document.

12 THE WITNESS: If the site is located --

13 MR. GAUKLER: Wait till you get more of the
14 document.

15 THE WITNESS: Okay.

16 I would like to have the title of the NUREG,
17 what the title of the NUREG 1567. Do you know the title
18 of the NUREG 1567 before I go into the --

19 MR. SEEL: No, but I can go upstairs and get
20 it for you if you'd like.

21 THE WITNESS: Okay. So I'm going to read
22 what you request on second paragraph.

23 MR. GAUKLER: Wait till he gets it.

24 (Recess from 11:11 to 11:19 a.m.)

25 THE WITNESS: Okay. Actually it's Review

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1 Plan, also the Reg Guide 1.17. That is my guess. I
2 just wanted to confirm that. Okay. Let me read to you
3 what you request, the second paragraph.

4 "If the site is located over an aquifer
5 which is a source of well water, the groundwater aquifer
6 (S) beneath the site, associated hydrological units, and
7 they are recharged and the discharge areas should be
8 described, the results of a survey of groundwater users,
9 well location, source aquifers, water uses, static water
10 levels, pumping rates, and the draw-down should be
11 provided.

12 A water table contour map showing surface
13 water bodies, decharge and discharge areas, and the
14 locations of monitoring wells to detect leakage from
15 storage structures should also be provided. Information
16 on monitoring wells should include well head elevations,
17 screened intervals, installation methods, and a
18 representative hydrochemical analysis. An analysis
19 bounding the potential groundwater contamination from
20 site operation should be provided. A graph of time
21 versus radionuclide concentrations at the closest
22 existing or potential downgradient well should be
23 included."

24 Q. In your expert opinion, has PFS performed
25 work that would comply with that paragraph?

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1 A. Some have. Some we plan to do. Because too
2 many mentioned there. I will identify which one we
3 already --
4 Q. In the first sentence it talked about an
5 aquifer.
6 A. Yes.
7 Q. Has PFS determined what the aquifer is?
8 A. In the ER itself, no, we have not identified
9 the aquifer.
10 Q. The first sentence states, "If the site is
11 located over an aquifer which is a source of well
12 water." If you've not identified the aquifer yet, could
13 you identify what the source, or the source for well
14 water?
15 A. We drill a CPT operating well and put a
16 casing on it and we found some groundwater.
17 Q. Would you please identify those areas in the
18 paragraph in which PFS has --
19 A. Okay.
20 Q. -- performed work and those which you
21 indicated that they would be performing in the future?
22 A. We have done to send either in the SAR or in
23 answer request for additional information from NRC the
24 result of a survey of groundwater user within five-mile
25 radius of the site -- well locations, source aquifer,

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1 water uses, static water levels, pumping rates. We have
2 described in the Skull Valley where the groundwater
3 recharge and decharge area.
4 That's all.
5 Q. You indicated that PFS has performed a
6 survey of the groundwater users?
7 A. Within five-mile radius of the site, yes.
8 Q. I'm sorry; what was that?
9 A. Within five-mile radius of the site.
10 Q. Why did PFS choose five miles?
11 A. Not only this site, any nuclear facility
12 required to investigate at the radius of five miles.
13 Q. If there were impacts to the environment or
14 impacts of the aquifer outside of five miles, would PFS
15 have studied that?
16 A. Not to my knowledge.
17 Q. PFS did not do an independent analysis as to
18 how far impacts to the aquifer may be caused?
19 MR. GAUKLER: Objection.
20 Q. Yeah, it was poorly worded. In your expert
21 opinion, is five miles the outer boundary at which
22 impacts to the aquifer may be observed at the site?
23 A. I can't answer your question. Will you
24 repeat the question? I'd appreciate.
25 Q. Is a five-mile radius a reasonable radius to

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1 be looking for impacts?
2 A. I don't like -- if I don't refer to
3 guideline, in my expert opinion is too conservative.
4 It's more than necessary. But the guideline required
5 it. In my expert opinion, it's too conservative, is
6 more than needed.
7 Q. And the reasons for it being too
8 conservative are?
9 A. I don't know. Because that is the -- I
10 don't know this requirement, because the -- what the
11 technical behind the NRC, they said the guidelines
12 saying that you have to have a radius of five miles. I
13 don't know. They may be -- my guess is because of
14 conservatism, because normally a -- well, I shouldn't
15 say that. I will stop here.
16 Q. Will the use of water at the facility have
17 an environmental impact on the aquifer?
18 MR. GAUKLER: Objection, vague and
19 ambiguous. Many type of potential of environmental
20 impacts, so if you have any particular ones in mind.
21 MR. WEISMAN: I'm sorry, Mr. Gaukler. Could
22 you speak up a bit?
23 MR. GAUKLER: I'm sorry. There's many
24 different types of environmental impacts. What type are
25 you referring to, in general?

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1 Q. (BY MR. SEEL) I'm referring to in general
2 draw-down of the aquifer and the impact it may have on
3 the availability of water resources in the valley.
4 A. Excuse me? You want me to address that?
5 Q. Yes.
6 A. I'd like you to repeat the question.
7 Q. I'd like to repeat it, too.
8 A. I don't understand it.
9 Q. Will the use of water at the facility have
10 an impact on the availability of water resources in the
11 valley?
12 A. I believe we have addressed the issue based
13 on our 42 years of average annual use of the water if we
14 coming -- withdraw from the well, and what kind of
15 impact on the nearest well user.
16 Q. PFS is not the only water user in the
17 valley, however. Is that correct?
18 A. In the valley, yes.
19 Q. Has PFS done an analysis to determine
20 whether the cumulative impact of all the water users in
21 the valley is having an adverse effect upon the
22 availability of water resources in the valley?
23 A. We did in one calculation demonstrate that
24 based on those 42 years annual actual rate, if we
25 withdraw that amount from the well aquifer what kind of

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1 impact would be on the current use of well water.

2 Q. Will there be sufficient water resources in
3 the valley to satisfy PFS's needs in 40 years?

4 A. Yes.

5 Q. And how did you come to that conclusion?

6 A. Based on that 42 years annual use is 2,040
7 gallon per year, transfer to 1.42 gallon per minute.
8 And also in other unit is 2.29 acre feet. That kind of
9 compared to the other user or the availability of the
10 aquifer is so insignificant.

11 Q. Where did you get the data to compare it to
12 these other -- where is the data for these other users
13 in the valley?

14 A. Oh, we based on those five -- a table or a
15 figure we presented within those five-mile radius.

16 Q. And you determined that the recharge to the
17 area within the five-mile radius is greater than what is
18 being extracted by those current water users?

19 A. I base on the -- what available from the
20 aquifer data which I extract an understanding from Hood
21 and Waddell, W-a-d-d-e-l-l, the paper, the publication.
22 I forgot the last name. And they indicate an aquifer in
23 the Skull Valley, how much recharge and decharge
24 quantity.

25 Q. So is PFS relying solely on the Hood and

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1 Waddell 1968 report for its conclusions, as to the
2 conclusion that recharged --

3 A. I believe we answered that question during
4 the answer one of the request for additional information
5 addressed. After Hood publication we have more reason
6 in 1987. Their conclusion is not too much different
7 from Hood. Also, I remind you the State of Utah using
8 Hood for their 1987 to host superconductor,
9 supercolliding project, they also rely on that report.

10 And we have to conduct some research.

11 There's just no more -- not a more recent publication
12 available.

13 Q. But PFS is relying on the Hood and Waddell
14 report in coming to this conclusion?

15 MR. GAUKLER: Objection. Mischaracterizes
16 the witness's testimony.

17 Q. (BY MR. SEEL) Is PFS relying on anything
18 other than the Hood and Waddell report to come to its
19 conclusion?

20 MR. GAUKLER: What conclusion are you
21 referring to specifically?

22 MR. SEEL: The conclusion that the amount of
23 recharge to the aquifer is greater than the amount being
24 used in the valley. If that's not the right
25 conclusion --

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1 A. We used the Hood information and get the
2 information about charge or recharge of the aquifer.

3 Q. How much is actually being used in the
4 valley today?

5 A. I don't know. They said some number in
6 there. I do not memorize the paper.

7 Q. I understand.

8 A. So many number.

9 Q. But if I understand you correctly, PFS is
10 relying on the number in the Hood and Waddell report for
11 its conclusion.

12 A. If I remember right, talking about 5,000
13 acre feet compared to what we propose going to draw,
14 2.29 acre feet. That -- my expert opinion is
15 insignificant.

16 Q. The question is whether the data from 1968
17 is still accurate, and my question to you is, why do you
18 feel the data from the 1968 report is still accurate?

19 A. I have answered already. Because previous
20 question, I don't know which question -- '87, they say
21 another publication concluded. Their study conclusion
22 is not much different from Hood's result.

23 Secondly, State of Utah using the same
24 report for 1987, their planning of this project.

25 Q. Was that facility located -- to be located

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1 in Skull Valley?

2 A. If I remember right, answer to that question
3 I think is using Skull Valley, yes, the groundwater from
4 the aquifer in the Skull Valley, yes.

5 Q. Are there any other reasons why you believe
6 the 5,000 acre feet figure included in the Hood and
7 Waddell report is still valid?

8 A. My conclusion I think based on all available
9 information. Oh, well, that's -- ever since the Hood
10 publication, the balance of the aquifer had not been
11 changed significantly.

12 Q. If new wells were being put into the
13 aquifer, installed in the aquifer since the Hood and
14 Waddell report, would that change your opinion?

15 A. That depend on a lot of factor -- how much
16 water individual well will withdraw.

17 Q. What other factors?

18 A. That's one of the factors I just mentioned,
19 depending on quantity of individually the withdraw from
20 the aquifer.

21 Q. Are there any other factors that would go
22 into that determination? Do new wells automatically
23 mean more extraction from the aquifer?

24 A. Yeah, if you have a new well you just
25 extract from the aquifer, yeah.

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1 Q. So has PFS determined how many new wells
2 have been installed in the aquifer since the Hood and
3 Waddell report?
4 MR. GAUKLER: I object to this whole line of
5 questioning on lack of relevance. You can answer that
6 question if you know.
7 A. I don't know.
8 Q. If the groundwater table is lower, would
9 that have an environmental impact on vegetation in the
10 valley?
11 A. If the groundwater table is low, I don't
12 know how that interconnected vegetation. I would say
13 no.
14 Q. Do some types of vegetation extract water
15 from the subsurface out around the groundwater table?
16 A. I don't know, because I'm not in that area
17 of my study.
18 Q. Are you familiar with the Hood and Waddell
19 report? Have you read it?
20 A. I read very casually, not word by word.
21 Q. Do you know what evapotranspiration is?
22 A. My understanding of that word means
23 evaporate and escaping to the air.
24 Q. What does the transpiration part of that
25 term mean?

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1 A. I only know the first part. Transpiration,
2 I don't know what exact mechanism in science.
3 Q. If the groundwater table is lower in the
4 valley, would that allow saline water from the Great
5 Salt Lake to encroach into the aquifer?
6 A. I don't know the answer to this question --
7 to your question.
8 Q. Is salt water generally denser than fresh
9 water?
10 A. True.
11 Q. Are you aware of any areas in the United
12 States where saline water has encroached on fresh water
13 aquifers?
14 A. Yes.
15 Q. What areas would those be?
16 A. Florida.
17 Q. Do you know what the cause of the
18 encroachment was?
19 A. I don't know the exact cause, but one thing,
20 the factor which determine is the distance between the
21 aquifer and what the source of salt water. That's a
22 very important factor.
23 Q. I'm going to hand you a copy of -- I'll hand
24 you all of the Hood and Waddell report. I'd like you to
25 look at page 28. There's a table on use --

1 A. Twenty-eight, okay.
2 Q. -- in which there is -- I'd like you to take
3 a look at it so that I can ask you about it.
4 A. Starts at page 28, right?
5 Q. Page 28, that's correct.
6 (Witness reviews document.)
7 MR. GAUKLER: Are you going to ask specific
8 questions with respect to the table?
9 MR. SEEL: About the dates on the table and
10 use during those dates.
11 MR. GAUKLER: He's going to ask a specific
12 question about the table. If you need to look at more
13 of the document, feel free to do so.
14 THE WITNESS: Okay. The table.
15 Q. (BY MR. SEEL) My understanding is that --
16 well, what does the table describe as far as use of
17 water in the Skull Valley?
18 A. The table is percent of -- is estimated well
19 discharge based mainly on a measurement made during a
20 reconnaissance during 1963 and '65, electrical power
21 consumption, acreage and pumpage, reported by the U.S.
22 Army.
23 Q. Can you tell me what the total usage of
24 water in 1957 was, according to that table?
25 A. Total rounded is 3,500. The unit is acre

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1 feet.
2 Q. Can you tell me what the amount estimated
3 according to the table is in the subsequent year?
4 A. 1963, no total. 1964, a total of 4,100. In
5 1965 is 5,000 acre feet.
6 Q. So between -- if I understand the table
7 correctly, Hood and Waddell estimate that between 1957
8 and 1965 the amount of water usage in the valley
9 increased by how many acre feet?
10 A. Nine hundred acre feet.
11 Q. In 19 -- my understanding is PFS has taken
12 the position that that 5,000 acre feet per year usage
13 rate has not changed since 1968 when the report was
14 written?
15 A. No. We say change means the available or
16 recharge of the aquifer.
17 Q. -- I'm sorry?
18 A. It's user, amount of use.
19 Q. I don't understand the difference. Would
20 you explain that to me? Is PFS relying on the 5,000
21 acre feet per year annual usage rate that Hood and
22 Waddell came up with as being the current usage rate?
23 A. No, we do not -- I don't believe we used
24 so-called usage, rather than we're using the first page.
25 If you look at the -- let's see, where's the -- right

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1 here. We present this number in our ER. Estimate every
2 annual groundwater recharge and discharge in the range
3 of 30,000 to 50,000 acre per year. We use that number
4 in our ER, SAR. We did not use this number anywhere, I
5 believe, in our ER or SAR. I may be wrong, but that's
6 my memory. That's what I had read those sections, ER
7 section, SAR section.

8 Q. Has PFS done any studies as to the current
9 amount of well usage in Skull Valley?

10 A. Recur amount?

11 Q. The current amount of water being pumped
12 from wells in Skull Valley.

13 A. I don't know of -- I don't understand your
14 "recur."

15 MR. GAUKLER: I object to this whole line of
16 questioning as relevance. You can answer if you can.
17 Go ahead and rephrase the question.

18 Q. Has PFS done any studies as to the annual
19 amount of water being pumped from wells in Skull Valley?

20 A. For all the user.

21 MR. GAUKLER: Entire Skull Valley, you're
22 talking about?

23 A. Entire Skull Valley? Not to my knowledge.

24 Q. Will the amount that's being pumped pump the
25 aquifer dry in 40 years?

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1 A. I don't understand your question. Forty
2 years, you're referring to Private Fuel Storage project?

3 Q. That is correct.

4 MR. GAUKLER: Objection; vague and
5 ambiguous, also lack of relevance.

6 Q. How do you know there's going to be any
7 water in the aquifer in 40 years?

8 MR. GAUKLER: Objection, lack of relevance.

9 A. I don't know answer to this question, your
10 question.

11 Q. Don't you need to know how much they pumped
12 in order to answer that question?

13 A. I know how much the PFS will pump, 2.29 acre
14 feet on every -- over 42 years life of the facility.

15 Q. And how do you know that the aquifer will
16 still be able to produce that much over the course of --

17 A. My expert opinion is compared to other user,
18 even -- this is insignificant.

19 Q. Precisely. And those other users are?
20 Where did you get the data about the other users?

21 A. Within five miles we presented in the ER and
22 SAR. They have quantity use, when they installed the
23 well, how deep of the well, what kind of elevation from
24 the ground surface to the water.

25 Q. And is the water table dropping in those

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1 wells?

2 A. Not significantly, based on the available
3 data to me.

4 Q. And what about in the rest of the Skull
5 Valley?

6 A. Oh, I've read a report. They say in the
7 Dugway, they say public water supply. In that
8 particular location is simply water elevation -- I mean,
9 groundwater elevation is significantly buried, reduced
10 because of pumping. But that is 19 miles from the site,
11 as I recall.

12 Q. So to clarify: the 5,000 acre feet that's
13 being used, that Hood and Waddell says is being used in
14 the valley, may or may not be accurate?

15 MR. GAUKLER: Objection. This is asked and
16 answered. We've gone over this many times. It's not
17 relevant, and now you should move on to a new topic.

18 MR. SEEL: If PFS wants to take the
19 position --

20 MR. GAUKLER: We said we don't rely upon the
21 5,000 feet. I don't see why you need to come back to
22 it. You've asked this many different ways. I've been
23 very patient. My patience is running out.

24 A. I'm not in a position to judge the Hood
25 paper to answer that. But I believe their data is very

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1 accurate, because they are very extensive, very thorough
2 study, based on my technical in this area. Very
3 thorough. One is a hydrologist, one is chemist. One or
4 the other.

5 Q. And it's a comprehensive inventory of the
6 water, groundwater resources in the valley?

7 A. Yes.

8 Q. Would you please turn to the last page of
9 that report.

10 A. Okay. This is -- 57 is some reference. The
11 last page?

12 Q. Page 40 of the report entitled "Proposals
13 for Additional Studies." Would you please read the
14 first two paragraphs of that?

15 A. Page 40, first two paragraphs. "Because
16 Skull Valley has a potential for development, a detailed
17 water resources investigation is needed to refine the
18 estimates given in this reconnaissance. Such a study
19 should include the following considerations:

20 1. A comprehensive inventory of the water
21 resources of the valley should be made to supplement
22 coverage of this reconnaissance. Detailed data should
23 be obtained on the hydraulic characteristics of existing
24 wells, the discharge characteristics of both the large
25 saline spring in the valley and the large mountain

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1 springs, the use of water in the valley, and the
2 availability of surface water supply."

3 Q. Do you agree that the authors of that report
4 seem to indicate that greater level of investigation is
5 required beyond what they did in Skull Valley? Strike
6 that.

7 Does the statement of the authors correspond
8 with your prior testimony that this was a comprehensive
9 report?

10 A. At the time I believe that's very
11 comprehensive. As a matter of fact, I did a lot of
12 research before coming here. All the conclusion at end
13 of the paper always recommend something further be done.
14 That's natural. Because nobody can claim, I'm the
15 exhaustive, this is it. Nobody would have the authority
16 saying that.

17 MR. SEEL: Lunch?

18 (Lunch Recess from 11:59 a.m. to 1:10 p.m.)

19 EXAMINATION

20 BY MR. WEISMAN:

21 Q. In answering one of the earlier questions,
22 you talked about two parameters, permeability and
23 transmittability.

24 A. Yes.

25 Q. I just wanted to make sure that I was clear

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1 on what the difference between the two of them is.
2 Maybe I can shortcut this just a little bit. I
3 understood from your answer that you measured
4 permeability at the surface from the top down.

5 A. Uh-huh.

6 Q. And I'm going to infer from your answer that
7 permeability of a sample of material may vary depending
8 on the direction. You might measure it from the top or
9 from the side, and you might get different answers. Is
10 that correct? So permeability could vary in the X, Y,
11 and Z directions? That's what I'm asking.

12 A. Yes. The answer is yes.

13 Q. Okay. So when you answered the question,
14 you said that you measured the permeability from the
15 surface. That's only in the up and down direction,
16 correct?

17 A. That's our pumping procedure defined, yes.

18 Q. Okay. So for transmittability, would that
19 be the permeability in a direction parallel to the
20 surface?

21 A. That is my understanding that the
22 transmittability is the horizontal.

23 Q. Okay. So that would be -- the only real
24 difference between permeability and transmittability
25 would be the direction of the flow; is that correct?

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1 A. When you say "only difference," I'm not
2 quite sure.

3 Q. I mean, they would use the same units.
4 You're measuring the same -- I'm asking if you're
5 measuring the same sort of thing, but the difference is
6 in the direction.

7 A. Yes.

8 MR. WEISMAN: Okay. That's the only
9 question I had.

10 THE WITNESS: Okay.

11 EXAMINATION

12 BY MR. GAUKLER:

13 Q. I had one short, quick question. We've
14 heard a lot of talk about units for expressing
15 permeability --

16 A. Yes.

17 Q. -- you just talked about. Is it true that
18 you can express permeability in units of area as the
19 function of time or in your distance over time?

20 A. Yes. I have seen different textbooks. One
21 textbook expand in the area over time. Some other
22 they're using linear distance over time. Others using
23 area over time.

24 MR. GAUKLER: Okay.

25 MR. GAUKLER: No further questions.

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1 MR. WEISMAN: I think we should go back on
2 quickly for one comment, and that is, Mr. Blake informs
3 me that the term is "transmissibility" and not
4 "transmittability." But I must have heard it wrong.

5 THE WITNESS: You're correct.

6 MR. WEISMAN: So with that, I will be done.

7 MR. SEEL: I may have some follow-up. Just
8 give me a second.

9 FURTHER EXAMINATION

10 BY MR. SEEL:

11 Q. As a follow-up to the questions that were
12 just asked on permeability, and permeability may vary
13 depending on the X, Y, or Z axes, the three dimensions
14 in space, has PFS done any testing to determine whether
15 the permeability in those three dimensions in the test
16 well screened area vary?

17 A. No.

18 Q. So they could be -- the permeability in all
19 three directions could be the same?

20 A. Could be the same, could be different.

21 Q. How would one go about determining whether
22 they're different or not?

23 A. I don't know. I don't know the method how
24 to determine the difference.

25 Q. When dealing with porous media -- and we're

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1 dealing with porous media flow; is that correct?

2 A. Uh-huh.

3 Q. Dealing with porous media such as silty
4 sand, would you expect the permeability to differ
5 depending on the dimension?

6 MR. BLAKE: Dimension or direction?

7 MR. SEEL: What's that?

8 A. Yeah, I don't understand dimension.

9 Q. I guess I'm using dimension as direction.

10 A. Direction, okay. Will you repeat the
11 question again?

12 Q. When you did -- let's step back. When you
13 did the pump test, there were certain assumptions built
14 into that pump test formula?

15 A. Yes.

16 Q. Was one of those assumptions that you're
17 dealing with porous media?

18 A. Yes.

19 Q. Was there another assumption that that
20 porous media is homogenous?

21 A. Was what?

22 Q. Homogenous?

23 A. What does that mean?

24 Q. Has the same characteristics in all three
25 dimensions.

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1 A. My understanding is we did not go into that
2 assumption, saying that different dimensions is
3 different or vary.

4 Q. You're experienced in groundwater modeling,
5 are you not?

6 A. Yes.

7 Q. Would groundwater models usually assume that
8 the apropos parameter is the same in all three
9 directions?

10 A. Normally we decide which dimension or
11 direction use depending on what direction you extract
12 the water. Vertically, say, then we're more focused on
13 the vertical direction, the permeability.

14 Q. I'm sorry, I didn't understand that. I just
15 didn't hear what you said.

16 A. Normally we focus the permeability dimension
17 is where we -- which direction our water were pumping
18 to. So vertical direction will focus on the
19 permeability in the vertical direction.

20 Q. Is that what the formula that was used in
21 the static head pump test assumes?

22 A. Yes, it is.

23 Q. It does not assume that the aquifer
24 parameters are all the same in all three directions?

25 A. I don't know the formula will require the --

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1 other than direction of the pumping flow, have to be --
2 provide as an input for that formula other than the
3 direction you're pumping the -- pumping the water out.

4 Q. Let's step back to the basics.

5 A. Okay.

6 Q. What is the formula based upon? The formula
7 that we use in the static head test, what formula, what
8 physical equation is it based upon?

9 A. Oh, it's based upon according to what
10 formula is in the Q and then the -- let me see. The
11 head of the -- define in the formula, because we just
12 take out from one of the reference. H is the -- let me
13 see how they defined H.

14 Q. Is that formula based upon Darcy's law? Are
15 you familiar with Darcy's law for fluid flow through
16 porous media?

17 A. I know the formula, yes.

18 Q. Does Darcy's law -- is one of the basic
19 assumptions of Darcy's law that you're dealing with
20 homogenous material of a uniform particulate size?

21 A. I think that's how the formula based upon,
22 uniform size.

23 Q. So based of Darcy's law, Darcy's law assumes
24 you're dealing with a medium in which the parameters of
25 that medium are the same in all three directions?

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1 A. When you say medium all the same in all
2 direction is the same group of soil or the size of soil,
3 or what?

4 Q. Permeability or the ability of fluid to
5 flow.

6 A. Yeah.

7 Q. That Darcy's law assumes that the medium
8 flows equally well in each direction.

9 A. I thought the thousand dollar assumption is
10 what they call homogeneous of the media of the soil. I
11 would say this is the same what you just inferred.

12 Q. So if the formula in this pump test is based
13 upon Darcy's law --

14 A. I don't know. I don't know that it is or
15 not, is or is not.

16 Q. Are you aware of any groundwater flow
17 formula which is not based on Darcy's law that involves
18 porous media?

19 A. If not homogeneous, is there another similar
20 Darcy's law formula which will apply in homogeneous
21 media of the soil, I don't know.

22 Q. What are the units for transmissivity?

23 A. If I remember right, it is area over time.

24 Q. And you say that is the same as
25 permeability? Is that how I understood your testimony?

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1 A. No. I say permeability can be expressed in
2 terms of area over time or linear over time.

3 Q. It can be expressed as both?

4 A. Yes.

5 MR. SEEL: No further questions.

6 (Deposition was concluded at 1:23 p.m.)

7 * * *

1 Case: In the Matter of Private Fuel Storage
Case No.: ASLPB No. 97-732-02-ISFSI
2 Reporter: Vicky McDaniel
Date taken: April 17, 2001

3 WITNESS CERTIFICATE

4 I, George H.C. Liang, HEREBY DECLARE:

5 That I am the witness referred to in the
6 foregoing testimony; that I have read the transcript and
7 know the contents thereof; that with these corrections I
have noted, this transcript truly and accurately
reflects my testimony.

8 PAGE-LINE CHANGE/CORRECTION REASON

16 _____ No corrections were made.

17
18
19 George H.C. Liang
20 SUBSCRIBED and SWORN to at
21 , this day of
22 2001.

24 Notary Public
25

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1 C E R T I F I C A T E

2 State of Utah)

ss.

3 County of Utah)

4 I, Vicky McDaniel, a Registered Merit
Reporter and Notary Public in and for the State of Utah,
5 do hereby certify:

6 That the deposition of George H.C. Liang,
the witness in the foregoing deposition named, was taken
7 on April 17, 2001, and that said witness was by me,
before examination, duly sworn to testify the truth, the
8 whole truth, and nothing but the truth in said cause;

9 That the testimony of said witness was
reported by me in stenotype and thereafter transcribed
10 into typewriting and that a full, true, and correct
transcription of said testimony so taken and transcribed
11 is set forth in the preceding pages.

12 I further certify that I am not of kin or
otherwise associated with any of the parties of said
13 cause of action and that I am not interested in the
event thereof.

14 WITNESS MY HAND and OFFICIAL SEAL at Saratoga
15 Springs, Utah, this 23rd day of April, 2001.

16
17
18 Vicky McDaniel, RMR
Utah License No. 87-108580
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In the Matter of Private Fuel Storage
George H. C. Liang * April 17, 2001

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PAGE-LINE	CHANGE/CORRECTION	REASON
5 17	in the fluid mechanics area	typo error
5 21	tunnel 55 feet long and then	typo error
6 4	I have involved in lot of projects	typo error
6 6	I participated in environmental report	typo error
6 9	which I participated in, what happens	typo error
6 10	, and then assume a scenario	typo error
6 11	that the fluid hit the ground and the	typo error
6 14	stations also involved, ... like Shoreham	typo error
6 18	if a storm occurs, results in runoff,	typo error
6 23	but at one point, I did involve.	typo error
6 24	Webster is a very diverse company.	typo error
7 2	technical personnel resource support	typo error
7 18	I was involved in pumping test when	typo error
7 19	As a matter of fact, I most recently,	typo error
8 14	-- if it has	typo error
8 15	something in well analysis, data came in	typo error
9 8	I mean, we still do lots of modeling	typo error

[continued on next page]

_____ No corrections were made.

George H.C. Liang
George H.C. Liang

SUBSCRIBED and SWORN to at Stoughton, Norfolk County, Comm. of Massachusetts
_____, this 15th day of May,
2001.

Emily S. Clegg
my commission expires: 5/24/2002
Notary Public

PAGE-LINE	CHANGE/CORRECTION	REASON
9 9	but not on the latest project.	typo error
9 11	models, surface water model, and run	typo error
9 12	the models.	
9 21	On sections,	typo error
9 22	in the environmental report	typo error
10 20	to use in remediation of	typo error
10 21	different models.	typo error
11 3	the areas when we prepare project report,	typo error
11 22	say those required steps is not saying that I participated in every step on PFS project have to go to the PFS project management.	typo error
11 23	specific for this I was brought on board	typo error
11 24	, so those considerations: the	typo error
11 25	format to do this and how it is determined,	typo error
12 1	I need to know specifically what area?	typo error
15 3	Environmental Report covers so many sections,	typo error
15 4	so many areas.	
15 5	And your question did I help prepare the environmental	typo error
15 6	report? I can not answer. All I can answer: I	typo error
15 7	prepared hydrology section of	typo error
15 13	We used references	typo error
15 14	, which has a NRC Reg guideline	typo error
15 18	by the reg guideline, all the resulting information, required by the	typo error
15 25	That is the reg guide, guideline gives you	typo error
16 2	Very detailed, what you should be used	typo error
16 25	or only few perennial streams,	typo error
17 1	very few, or none at the site.	typo error
17 17	we have found is some reservoirs or ponds	typo error
18 19	well, CBT No.5, which we installed a casing	typo error
21 1	They analyzed the soil at the Skull Valley.	Typo error
22 14	In my engineering experience, we say this	typo error
22 15	order of magnitude.	typo error
22 21	, not only when you hit the aquifer,	typo error
22 22	only depending upon permeability, but also depending upon so-called	typo error
22 24	There are two	typo error
22 25	coefficients in there.	Typo error
23 6	You have another coefficient also affecting	typo error
27 17	back on the reference based formula or the reason it derived	typo error
27 19	I believe the formula also defines the way	typo error
28 1	by the unit of individual terms.	Typo error
28 6	I just calculate the unit and come out --	typo error
28 7	after I cancelled all same units in this calculation,	typo error
29 25	Normally we extract water when we hit this	typo error
30 1	water coming out, hit a depth which	typo error
30 2 & 3	It could be deeper or shallower at some other	type error
30 4	locations. But at that spot, yes, we have a silty sand type of soil and we hit the water.	typo error
31 11	Actually, there are two ways.	typo error
31 12	don't want the surface water to go down	
31 13	surface water quality will be	typo error
32 3	a Driscoll's book, authored by Driscoll,	typo error
32 6	Is very important to follow the guideline	typo error
33 20	Because, as I said earlier, it prevents	typo error
33 23	As I said earlier, the bentonite	typo error
34 1	keeps the water which you pump from the well casing, is clear.	typo error

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PAGE-LINE	CHANGE/CORRECTION	REASON
34 3	This practice is also for any	typo error
34 4	residential use when you have your own	typo error
35 1	After the information was presented in the ER.	typo error
37 25	You say taken the	typo error
38 5	Were these in the ER or SAR, I forgot, we'd	typo error
38 6	say there is very little chance to infiltrate	typo error
38 25	, you know, because you drill a hole, so	typo error
39 1	those are coming from the side way.	typo error
39 20	everything follow the rule and procedure, or	typo error
40 9	which originally came from the hole	typo error
40 20	specifically in the ER, CBT No. 5	typo error
41 1	make some field notes.	typo error
42 6	colleague who is in Denver	typo error
42 17	It is my belief, yes.	typo error
43 1	That is the area I'm not in a position to	typo error
43 2	answer, because the engineer designed the	typo error
	sewer system would	
44 21	No, because I'm not involved in the original	typo error
45 11	I remember the ER Sections have addressed	typo error
45 14	identify the sources of the water come from.	typo error
45 19	much water used during different phases of	typo error
45 20	project, from construction to operation phase	typo error
48 13	water bodies, recharge and discharge areas.	typo error
49 22	We have done and sent to NRC either in the SAR	typo error
49 23	answering to request for additional information	typo error
	from NRC, the	
50 2	described in the ER: in the Skull Valley where	typo error
50 3	recharge and discharge area.	typo error
51 2	I don't like to go to a five-mile radius.	typo error
51 3	the guideline. In my expert opinion it is too	typo error
51 5	, it's too conservative, and is	typo error
51 9	I don't know. Because that is the guideline.	typo error
51 10	don't know the bases of this requirement,	typo error
	because the guideline what the	
51 11	technical bases behind the NRC's thinking. The	typo error
	guideline	
51 12	saying that you have to cover a radius of five	typo error
	miles. I	
51 14	, because normally a pumping well, I shouldn't	typo error
52 24	based on those 42 years annual average rate,	typo error
53 6	Based on that 42 years annual average use	typo error
53 7	gallon per day, convert to 1.42 gallon	typo error
53 8	unit is 2.29 acre feet per year. That amount	typo error
53 15	within a five-mile radius	typo error
53 23	, how much recharge and discharge	typo error
54 4	the answer to one of the request for	typo error
54 5	we have found one more recent reference	typo error
	published	
54 8	Hood data for their 1987 effort to estimate	typo error
	water needs for hosting the Superconducting	
54 9	Supercollider Project. They also rely on	typo error
55 2	information about discharge or recharge of	typo error
55 20	, I don't know which question. I said in '87,	typo error
55 24	, their proposal planning of hosting SSC project	typo error
56 9	Oh, well, that's the conclusion ever since	typo error
61 10	Current amount?	typo error
61 14	"Current."	typo error
62 14	feet per year over 42 years life of	typo error
63 6	I've read a report. It said in	typo error
63 7	Dugway, there is a public water supply.	typo error
63 8	location was sampled for water elevation	typo error
	changes.	

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PAGE-LINE	CHANGE/CORRECTION	REASON
63 9	is significantly lowered, and reduced	<u>typo error</u>
63 21	5,000 acre-feet.	<u>typo error</u>
64 2	, based on my technical experience in this area	<u>typo error</u>
64 3	One of the authors is a hydrologist, the	<u>typo error</u>
	other is a chemist	
67 21	textbook expressed in the area over time unit	<u>typo error</u>
72 9	I thought the assumption is	<u>typo error</u>
72 11	would say this is the same as what you just	<u>typo error</u>

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<p style="text-align: center;">0</p> <p>0.142 (1) 19:10 0.2 (1) 21:12 0.44 (1) 22:3 0.6 (1) 21:12</p> <hr/> <p style="text-align: center;">1</p> <p>1 (4) 22:4 34:16 35:24 64:20 1.17 (1) 48:1 1.2 (4) 21:24 22:2,5,6 1.42 (1) 53:7 1:10 (1) 65:18 1:23 (1) 73:6 10:25 (1) 34:9 10:41 (1) 34:9 100 (1) 3:14 11:11 (1) 47:24 11:19 (1) 47:24 11:59 (1) 65:18 119 (1) 16:5 120 (1) 21:25 122 (1) 30:13 125.5 (1) 30:13 142 (3) 19:1 21:10,25 1567 (3) 47:7,17,18 17 (1) 74:7 19 (2) 60:11 63:10 1957 (2) 59:24 60:7 1963 (2) 59:20 60:4 1964 (1) 60:4 1965 (2) 60:5,8 1968 (4) 54:1 55:16,18 60:13 1987 (3) 54:6,8 55:24 1999 (1) 24:10</p> <hr/> <p style="text-align: center;">2</p> <p>2 (8) 6:15 20:23 21:13 24:20 34:16 35:24 46:24 47:3 2,040 (1) 53:6 2-12 (1) 46:24 2-23 (2) 20:24 21:6 2.29 (3) 53:8 55:14 62:13 2.4.5 (1) 46:25 2.6-2 (1) 34:15 2.6-23 (1) 20:10 2001 (4) 24:21 74:7,15 75:22 20037-1128 (1) 2:8 22nd (1) 24:10 23rd (1) 74:15 24 (1) 36:10 27 (1) 24:21 28 (3) 58:25 59:4,5 29 (3) 25:13,14,16</p> <hr/> <p 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