

STATE OF NEW MEXICO
ENERGY, MINERALS, AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION COMMISSION

IN THE MATTER OF THE HEARING CALLED
BY THE OIL CONSERVATION COMMISSION FOR
THE PURPOSE OF CONSIDERING:

COPY

APPLICATION OF LIGHTNING DOCK GEOTHERMAL Case No. 15357
HI-01, LLC, FOR APPROVAL TO INJECT INTO A
GEOTHERMAL AQUIFER THROUGH THREE PROPOSED
GEOTHERMAL INJECTION WELLS AT THE SITE OF
THE PROPOSED LIGHTNING DOCK GEOTHERMAL POWER
PROJECT, HIDALGO COUNTY, NEW MEXICO.

and
APPLICATION OF LIGHTNING DOCK GEOTHERMAL
HI-01, LLC, TO PLACE WELL NO. 63A-7 ON Case No. 15365
INJECTION-GEOTHERMAL RESOURCES AREA,
HIDALGO COUNTY, NEW MEXICO

REPORTER'S TRANSCRIPT OF PROCEEDINGS
COMMISSION HEARING
Volume III
October 7, 2015
Santa Fe, New Mexico

BEFORE: DAVID R. CATANACH, CHAIRPERSON
ROBERT S. BALCH, COMMISSIONER
PATRICK PADILLA, COMMISSIONER
BILL BRANCARD, ESQ.

This matter came on for hearing before the
New Mexico Oil Conservation Commission on Thursday
October 7, 2015, at the New Mexico Energy, Minerals, and
Natural Resources Department, Wendell Chino Bldg,
1220 South St. Francis Drive, Porter Hall, Room 102,
Santa Fe, New Mexico.

REPORTED BY: ELLEN H. ALLANIC
NEW MEXICO CCR 100
CALIFORNIA CSR 8670
PAUL BACA COURT REPORTERS
500 Fourth Street, NW
Suite 105
Albuquerque, New Mexico 87102

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1 A P P E A R A N C E S
2 FOR APPLICANT LIGHTNING DOCK GEOTHERMAL
3 HI-01, LLC:

4 Michelle Henrie, Esq.
5 MHENRIE
6 225 E. De Vargas
7 Santa Fe, New Mexico 87501-2703
8 (505)842-1800
9 michelle@mhenrie.com
10 and
11 Patrick J. Rogers, Esq.
12 patrogers@patrogerslaw.com

13 FOR PROTESTANT AMERICULTURE and DAMON SEAWRIGHT:
14 Charles N. Lakins, Esq.
15 Lakins Law Firm, P.C.
16 P.O. Box 91357
17 Albuquerque, New Mexico 87199
18 (505) 404-9377
19 charleslakins@gmail.com

20 FOR THE NEW MEXICO OIL CONSERVATION DIVISION:
21 ALLISON R. MARKS, Esq.
22 Oil Conservation Division
23 Assistant General Counsel
24 Energy, Minerals and Natural
25 Resources Department
26 1220 South St. Francis Drive
27 Santa Fe, New Mexico 87505
28 (505)476-3462
29 allisonr.marks@state.nm.us

30 Also Present:
31 Meira Gault, Supervisor, Hidalgo Soil and Water
32 Conservation District
33 Scott Richins

1	H E A R I N G I N D E X			
2	PROTESTANT AMERICULTURE			
3	CASE-IN-CHIEF:			
4	WITNESS DANIEL HAND			
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6	By Ms. Henrie	Cross-Examination 50	Recross	Further
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E X H I B I T I N D E X

PROTESTANT AMERICULTURE EXHIBITS
Offered and Admitted

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Lightning Dock Geothermal HI-01, LLC, Exhibits
Offered and Admitted

Lightning Dock Geothermal HI-01, LLC, Exhibit 15	PAGE 14
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1 (Time noted 1:11 p.m.)

2 COMMISSIONER CATANACH: At this time, we
3 will call case 15357 and case 15365, which is the
4 Application of Lightning Dock Geothermal HI-01, LLC, to
5 place certain wells on geothermal injection at the site
6 of a Lightning Dock Geothermal Power Project, Hidalgo
7 County, New Mexico.

8 Call for appearances today.

9 MS. HENRIE: Mr. Chairman, Michelle Henrie
10 for Lightning Dock Geothermal, and with me is
11 co-counsel, Pat Rogers, who has entered his appearance
12 in this case.

13 MS. MARKS: Allison Marks on behalf of the
14 Oil Conservation Division.

15 MR. LAKINS: Good afternoon, Mr. Chairman,
16 Commissioners, Charles Lakins on behalf of the
17 Protestant, AmeriCulture.

18 MS. GAULT: Meira Gault, Supervisor with the
19 Hidalgo Soil and Water Conservation District, replacing
20 the lady that was here last time.

21 COMMISSIONER CATANACH: And your name again
22 is?

23 MS. GAULT: Meira, M-e-i-r-a, Gault.

24 COMMISSIONER CATANACH: I believe at the
25 conclusion of the last hearing, I believe we finished up

1 with Lightning Dock as far as your direct case?

2 MS. MARKS: Mr. Chairman, I just have a
3 preliminary matter before we begin.

4 I filed a notice of errata and a motion to
5 correct the record. I do have copies of it. Counsel
6 for AmeriCulture did not object. Counsel for Lightning
7 Dock supported the motion and the errata. And I did not
8 hear from the Soil and Water Conservation District. I
9 do have extra copies.

10 COMMISSIONER CATANACH: Did we get copies of
11 this?

12 MS. MARKS: They were filed with the clerk.
13 Ms. Davidson is saying...

14 COMMISSIONER CATANACH: Can you just briefly
15 explain what this is?

16 MS. MARKS: Sure. There was an error in the
17 transcript. I do also have the proposed findings of
18 fact and conclusions of law, which was in the procedural
19 order, which all parties were supposed to bring to the
20 hearing today. So I have those as well for the
21 Commission.

22 But when I was reviewing the transcript, I
23 noticed an error in the transcript. It is on page 201
24 of the second day's proceedings. It's on lines 16
25 through 18. And the comment there is attributed to

1 Ms. Henrie, and I actually made the comment.

2 And the comment is in reference to a letter
3 that was submitted by the Geothermal Energy Association,
4 the letter was I believe e-mailed to members of the
5 commission, Mr. Brancard, and myself. And Ms. Henrie
6 and Mr. Lakins did not receive a copy of the letter.

7 So if you review the transcript -- I did not
8 make copies of the entire transcript. I do have one
9 copy here -- it does not make sense for the comment to
10 be attributed to Ms. Henrie. Neither party objected.
11 Again, I don't know the position of the Soil and Water
12 Conservation District.

13 So I did ask for the transcript to be
14 corrected and for Paul Baca -- sorry, I don't know the
15 full name -- but I would ask that the Commission take
16 the appropriate steps to make sure that the transcript
17 from day two's proceedings are correct -- I make that
18 motion -- and for the errata in the transcript to be
19 corrected.

20 COMMISSIONER CATANACH: Mr. Brancard, do we
21 just vote on that motion?

22 MR. BRANCARD: Sure. We can direct the
23 court reporter to check the record and make the change.

24 COMMISSIONER CATANACH: So do we vote on it?

25 COMMISSIONER BALCH: I would move to make

1 the amendment.

2 COMMISSIONER PADILLA: I would second that
3 motion.

4 COMMISSIONER CATANACH: All in favor.
5 (In Unison "Aye.")

6 MR. ROGERS: And we have a couple of
7 procedural housekeeping matters, too, if this would be
8 the appropriate time.

9 We have extra copies of that same letter if
10 there is any shortage of those. May I approach and give
11 those to Mr. Brancard?

12 COMMISSIONER CATANACH: Sure.

13 MR. ROGERS: And on behalf of Lightning
14 Dock, we have our proposed findings of fact and
15 conclusions of law. I think the Commission was kind
16 enough to address my motion, which indicated the
17 importance of these, and, pursuant to the order, we have
18 those here at this time.

19 And I will again give those to Mr. Brancard.

20 MR. BRANCARD: And so we are also receiving
21 the Oil Conservation Division's Proposed Findings of
22 Fact, and I believe AmeriCulture has already placed its
23 proposed findings of fact with us.

24 MR. LAKINS: Yes, sir.

25 MR. ROGERS: And, again, on the housekeeping

1 and procedural front on behalf of Lightning Dock, we
2 have an e-mail from Mr. Ashburn from the Deming Luna
3 County Economic Development Corporation that we would
4 like to make part of the record.

5 May I approach Mr. Brancard?

6 COMMISSIONER CATANACH: Yes.

7 MR. ROGERS: Lightning Dock -- before we
8 rest, we have -- there is some testimony from Mr. Scott
9 Richins, very brief, that we would like to present. He
10 is from the community. And, additionally, we have two
11 letters, very short, that we would like Mr. Morrison of
12 Lightning Dock -- he is the vice president of
13 operations -- to read into the record.

14 MR. LAKINS: I'll object to further witness
15 testimony, witnesses who were not disclosed.

16 I think the two letters speak for themselves
17 and they can be made a part of the public record. But I
18 object to another witness being called to read into the
19 record letters from private individuals who are not here
20 to speak for themselves.

21 MR. BRANCARD: Mr. Chairman, I suggest that
22 we have a period today to allow for any public comment
23 here, nontechnical testimony.

24 COMMISSIONER CATANACH: Okay.

25 MR. BRANCARD: We normally do that every day

1 of the hearing, allow for nontechnical comments.

2 MR. ROGERS: Thank you.

3 One of the issues with regard to
4 Mr. Richins, this being a long way from Deming, if you
5 would allow him at this point because he has to get
6 back. I've been assured that it's very short testimony,
7 but if you wouldn't mind taking that out of order to
8 allow Mr. Richins that accommodation, it would be
9 appreciated.

10 Mr. Morrison, the vice president of
11 operations, is only presenting letters from, again,
12 nontechnical persons similar to what has been allowed
13 thus far.

14 So my request would be that Mr. Richins be
15 allowed just briefly at this time because of his need.
16 He drove up, but needs to get back.

17 COMMISSIONER CATANACH: Okay. We will
18 accommodate that. He can go ahead.

19 MR. BRANCARD: Before we do that, can we
20 make sure we have all the preliminary matters done here.

21 MR. ROGERS: That's it for Lightning Dock.
22 Thank you for your attention.

23 MR. LAKINS: I provided the commission with
24 a proposed order; essentially, it's the same thing as
25 findings of fact, just titled differently. It was

1 Mr. Catanach's requirement to do that at the last
2 hearing.

3 I also have one change to our exhibits. Our
4 Exhibit V, as in Victor, to the PowerPoint presentation,
5 we just added some pages to it. And I have new sets,
6 which Florene has. And so just to take out the old and
7 stick in the new kind of thing would be the simplest way
8 to do it.

9 MR. BRANCARD: Mr. Lakins, do the other
10 parties have copies of --

11 MR. LAKINS: Yes, sir.

12 MR. BRANCARD: Do you have one for the court
13 reporter?

14 MR. LAKINS: I gave six up here to
15 Ms. Davidson, so that should include one for the --

16 MS. MARKS: I didn't re- --

17 MS. LAKINS: I need to give you one.
18 (Handing to Ms. Marks.)

19 MR. LAKINS: That's all from me.

20 COMMISSIONER CATANACH: Is that an issue,
21 Ms. Marks?

22 MS. MARKS: I mean I can look at it. I just
23 don't want any party to have an unfair advantage. And I
24 think this time, you know, the extension of time has
25 probably allowed one party to have an unfair advantage.

1 And I think probably that should probably be considered
2 by the Commissioner.

3 COMMISSIONER CATANACH: You just added pages
4 to the exhibit?

5 MS. MARKS: I don't know what the added
6 pages are. I just think as a matter of fairness for the
7 other party -- I don't know what the additional pages
8 are. I haven't reviewed them. That's for the
9 Commission to -- in regard to fairness.

10 MR. LAKINS: Those would be part of
11 Mr. Witcher's testimony, which we may get to later this
12 afternoon.

13 COMMISSIONER CATANACH: I think it will be
14 covered on direct. And I understand your concern, but I
15 think we should move on now.

16 MS. MARKS: And as another procedural
17 matter, the map that we have been referring to, I don't
18 know if it has been admitted as an exhibit. I'd just
19 like to make sure that's an exhibit.

20 MS. HENRIE: Yes, let's move that as an
21 exhibit. That would be --

22 COMMISSIONER BALCH: Do you have a
23 small-scale version of that?

24 MS. HENRIE: I do not. I thought that the
25 Commission could just take the board with them.

1 I can get you a small version, Bill, but it
2 won't have the drawing on it, you know, it won't have
3 where the wells are and things like that that have been
4 added to it, where the power plant is.

5 COMMISSIONER BALCH: The record is --

6 THE COURT REPORTER: I'm sorry, I couldn't
7 understand you.

8 MS. HENRIE: I'm sorry?

9 I could take a picture --

10 MS. MARKS: I could take a picture with my
11 phone.

12 MR. BRANCARD: We'll figure that out at some
13 point.

14 MS. MARKS: I would just like to make sure
15 it's an exhibit. We've been referring to it a
16 lot and --

17 COMMISSIONER CATANACH: So are we going to
18 admit that as an exhibit?

19 MS. HENRIE: Let's please admit that as
20 Lightning Dock Exhibit 15.

21 COMMISSIONER CATANACH: Any objection?

22 MR. LAKINS: No, sir.

23 COMMISSIONER CATANACH: Exhibit 15 will be
24 admitted as evidence.

25 (Lightning Dock Geothermal HI-01, LLC,

1 Exhibit 15 offered and admitted.)

2 COMMISSIONER CATANACH: Any other procedural
3 matters?

4 MR. BRANCARD: To clarify, everyone got of
5 Lightning Dock's -- was it Exhibit 14 that you
6 submitted?

7 MS. HENRIE: Lightning Dock Exhibit 14 was
8 the confidential cross sections. This board would be
9 Exhibit 15.

10 MR. BRANCARD: But after the last hearing,
11 we requested that you submit a better version of one of
12 the exhibits, and I don't know which one it was.

13 MS. HENRIE: It was Exhibit 11. It was
14 Dr. Miller's slides. And I did provide those to
15 Florene.

16 MR. BRANCARD: And everyone has received
17 that?

18 MR. LAKINS: I think I left my set on your
19 table. You gave me a set, and I think I left that on
20 your table.

21 MS. HENRIE: Sure.

22 MR. BRANCARD: I just want to make clear
23 that we asked that that be dealt with in between
24 hearings and that it was dealt with.

25 MS. HENRIE: Yes. Thank you.

1 Mr. Chairman, did we come to the conclusion
2 on AmeriCulture's new exhibit? We would like to object
3 to that; Exhibit V, as in Victor, is that correct?

4 MR. LAKINS: Yes.

5 MR. ROGERS: Mr. Chairman, it is our
6 understanding with the exception of just two pages that
7 that is a completely new exhibit of 15, 16, or 17 pages.

8 Would that be correct, Mr. Lakins, that --

9 MR. LAKINS: That's probably true. We are
10 going to go through them as a visual aid PowerPoint
11 presentation as it is. They will be on the screen.
12 They will be discussed by my expert. If you want to
13 object to certain additions, certain pages, at that
14 time...

15 MR. ROGERS: Just so the objection is clear,
16 one of the concerns about Lightning Dock has been the
17 lack of specificity with regard to objections. The
18 deadlines for exhibits has come and gone, and to provide
19 these on the day of the hearing is prejudicial and
20 should not be allowed.

21 MS. MARKS: I would add to the objection --

22 MR. LAKINS: In all fairness, that's exactly
23 what happened to us the first time around. There were
24 exhibits that were brought and shown that we had not
25 seen before.

1 And this is a PowerPoint presentation that
2 will be utilized through Mr. Witcher. I'm providing a
3 copy of the complete PowerPoint presentation as our
4 proposed V. It hasn't even been moved into evidence
5 yet. The prior V was not, we haven't even gotten to it
6 yet.

7 MR. BRANCARD: We can deal with it when we
8 get to that part of it. Is each witness going to use
9 this PowerPoint?

10 MR. LAKINS: One.

11 MR. BRANCARD: This is just Mr. Witcher's
12 PowerPoint?

13 MR. LAKINS: Yes, sir.

14 COMMISSIONER CATANACH: Just hold off.

15 MR. BRANCARD: Yes.

16 MR. ROGERS: May I ask at this time are
17 there any additional new exhibits that we might look at
18 now? Are there any other ones that are new that we
19 might receive now?

20 MR. LAKINS: The only other thing I have is
21 this diagram which is going to be discussed by Mr. Hand
22 that he prepared. I could make it an exhibit.

23 MR. ROGERS: Do you have a hard copy of that
24 that we might have?

25 MR. LAKINS: (Handing.)

1 MR. ROGERS: Thank you.

2 MR. LAKINS: Yes, sir.

3 COMMISSIONER CATANACH: Anything else at
4 this time?

5 MS. HENRIE: Can we present the nontechnical
6 testimony of Mr. Richins?

7 COMMISSIONER CATANACH: Yes.

8 STATEMENT BY MR. RICHINS

9 MR. RICHINS: I am Scott Richins,
10 R-i-c-h-i-n-s.

11 Mr. Chairman, as stated, I am a local
12 businessman in Hidalgo County, more specifically
13 Animus/Cotton City Area. I am a provider on the current
14 project as well as other places throughout the county.

15 With this project alone, it has been able to
16 provide several families income, employment. It has
17 been a good economic boon to the area. And we have
18 families that are needing -- using this as income and to
19 provide for other families, as well as it's one of my
20 customers that I am contracted to work with and provides
21 for my family and the company, which is Jhus Canyon
22 Construction, LLC.

23 The area is economically deprived, and it is
24 a boon to have this job market and potential power plant
25 expansion and use in the area. I would urge you to

1 approve and thank you very much.

2 COMMISSIONER CATANACH: Thank you,
3 Mr. Richins.

4 MR. ROGERS: That's all. Thank you.

5 MR. BRANCARD: Did you have other letters --

6 MR. ROGERS: Yes, we do. Would you like
7 those done at this time?

8 MR. BRANCARD: Let's get it out of the way
9 here.

10 MR. ROGERS: This is Mr. Morrison, the vice
11 president of operations.

12 MR. MORRISON: Good afternoon,
13 Commissioners --

14 MR. BRANCARD: Is he presenting a letter --
15 I mean --

16 COMMISSIONER CATANACH: I think we're going
17 to let him make a statement later, right?

18 MR. BRANCARD: I don't know. Is he just
19 presenting other people's letters or --

20 MR. ROGERS: Yes.

21 MR. BRANCARD: Then can't we just have the
22 letters for the record?

23 MR. LAKINS: That's my point.

24 MR. BRANCARD: We don't need the witness
25 really. We can just have the letters.

1 MR. ROGERS: Okay. Here's copies. Thank
2 you.

3 MR. BRANCARD: The other party has seen the
4 letters and no objections?

5 MR. LAKINS: We were given a copy.

6 MR. BRANCARD: Okay.

7 COMMISSIONER CATANACH: At this time, we
8 will turn it over to Mr. Lakins.

9 MR. LAKINS: Yes, sir. I call Daniel Hand.

10 COMMISSIONER CATANACH: Would you stand to
11 be sworn in, please.

12 DANIEL HAND
13 having been first duly sworn, was examined and testified
14 as follows:

15 DIRECT EXAMINATION

16 BY MR. LAKINS:

17 Q. Good afternoon, Mr. Hand. Can you hear me okay?

18 A. I can hear you.

19 Q. I sometimes don't speak very loudly, so let me
20 know.

21 A. I need all the help you can give me.

22 Q. Okay. Please introduce yourself.

23 A. My name is Dan Hand. I am a mechanical engineer.
24 I am licensed here in New Mexico as a professional
25 engineer. I'm licensed in several other states.

1 I have a master's degree in mechanical
2 engineering, and my focus has been energy. And since
3 about 2001, I have been working predominantly in the
4 geothermal arena.

5 Q. Mr. Hand, let's kind of start with your
6 education. So could you kind of give us a summary of
7 that, please.

8 A. Sure. My education is very traditional in
9 fluids, in heat transfer, and thermodynamics. I
10 graduated from the University of Arizona. I did a
11 master's level thesis in anisotropic conduction and
12 laminated solids.

13 It's got similarities to what we are looking at
14 today, because the flow pads that we have, you don't
15 have isotropic conditions throughout the medium where
16 we're trying to make flow go. And so the heat
17 conduction problem that I presented the first closed
18 form solution for has a lot of relevance to what we are
19 looking at in this particular situation.

20 Q. What are your degrees in?

21 A. My degree is a master's of science in mechanical
22 engineering. My undergraduate degree is from West
23 Point. It is a bachelor of science.

24 The reason I got a master's degree was to go back
25 and teach thermodynamics and fluid mechanics at West

1 Point. And I did that for three years.

2 Q. And I believe we have Mr. Hand's resume. Ms.
3 Davidson has a copy of that.

4 MR. LAKINS: If you could pass that to the
5 Commissioners. And I provided a copy to you as well.

6 Q. Mr. Hand, you mentioned some licenses. Could you
7 give us a rundown of what license you have in what
8 states?

9 A. Sure. I am licensed in eight western states as a
10 professional engineer. My first license dates back to
11 1983. And I have done a lot of engineering things.

12 In the service, it was mainly civil kind of
13 engineering. It's been energy since I went back to grad
14 school predominantly, and looking at all kinds of energy
15 systems.

16 Lately, it has been the geothermal. But prior to
17 that, I looked at a lot of turbo machinery pumps, power
18 plants. And when I say power plants, I studied energy
19 at the University of Arizona. And it was predominantly
20 traditional forms of energy, coal-fired power plants,
21 gas-fired power plants, the Rankine cycle, the gas
22 turbine cycle, the Brayton cycle it's called. And then
23 cycles that we use in internal combustion or engines,
24 the auto cycle.

25 I mean there's almost no energy system that you

1 could bring me that I wouldn't be familiar with or be
2 able to model. And modeling is an important part. What
3 you want to do is set it up so whoever you are working
4 for, whether a state or a public entity, that you don't
5 set them on a wrong path.

6 And a lot of these things we know when we know
7 how mechanical systems behave. They all behave
8 according to the fundamental laws of nature. And there
9 are just a few of those to set things straight.

10 Q. Mr. Hand, tell us about your work experience
11 after college. What have you done?

12 A. Well, after college, in the army -- I mean, I
13 have a successful career in the army. I retired in
14 1994. And I did a lot of traditional things that you
15 see the Corps of Engineers doing. And since then, I
16 have worked in the energy market, looking at all kinds
17 of machines and devices that consume and use power.

18 Starting about 2001 when I was working for
19 Chevron, I got involved in geothermal and looking at
20 wells and drilling and, you know, subsurface stuff. In
21 a little town in Oregon, we built a \$23,000,000 power
22 plant, organic ranking cycle power plant.

23 And I actually got that project started, did the
24 additional engineering. I mean, it has three wells. I
25 mean, I flow tested the wells. Built the equipment to

1 do the flow testing. And that project is now producing
2 power.

3 I worked at a school district that had an
4 injection problem, which is not entirely dissimilar from
5 what we have here. The water is not going where you
6 want it to go basically.

7 And we solved that problem for the school
8 district. I mean, the solution was to get the water off
9 site. In this case the water was not contaminated. It
10 was drinkable water. So putting it in the local river
11 was not an issue, and that was actually the solution.

12 Q. Tell us about your experience, particularly
13 concentrating on geothermal aspects of your work since
14 2001.

15 A. Sure. I have analyzed half a dozen or more
16 resources for how much power you could make. And I've
17 then done the initial engineering for what you could
18 do -- I mean, the kind of power plant, the size devices
19 you would need, the turbines, what type of turbine, how
20 much cooling, were you going to go with a dry tower or a
21 wet tower.

22 And I've worked for the DOE geothermal technology
23 program as an expert reviewer to review proposals that,
24 you know, come up for funding, and, especially, in the
25 lower temperature, power kind of environment, which is

1 what we have at Lightning Dock.

2 You know, the Lightning Dock temperature is a
3 very good temperature at 312, but it is still relatively
4 low temperature geothermal. And the technology used
5 there is an organic ranking cycle, which I have a lot of
6 experience analyzing.

7 Q. What else?

8 A. Say that again?

9 Q. Does that kind of summarize it?

10 A. Yes.

11 Q. Talk to me about your experience in fluid
12 dynamics.

13 A. I have done a lot of fluids problems. And there
14 is almost no energy device that we have that doesn't
15 also involve fluids. Fluids gets complicated fast when
16 you get down to the nitty-gritty.

17 But if you stand back and look at the big
18 picture, what is it we are doing, you know, those kinds
19 of things, you can come to a good common sense thing.

20 And what I try to do for all my clients is to
21 make sure that we are not proposing to violate any kind
22 of laws of nature. I mean, even if you do that, mother
23 nature will not allow it. So it's to try to keep
24 projects on track and to try to provide good advice that
25 keeps you from doing things that are outside of the

1 realm of being reasonable.

2 Q. How about your experience in analyzing geothermal
3 resources?

4 A. Yes, I have analyzed geothermal resources. I
5 have done it in the state of Oregon for about three
6 sites. The state here in New Mexico, I have worked
7 analyzing at least two sites. I mean, I looked at a
8 geothermal power plant that was a solar hybrid mix for
9 the pueblo that's actually your state flag, the Zia
10 Pueblo. I did that under a DOE funded project.

11 And the low temperature resources almost always
12 comes down to organic ranking. That's what you wind up
13 looking at.

14 Q. As part of your work for the DOE, did that
15 involve analyzing geothermal resources?

16 A. Yes. To add to that, I mean what you need is
17 flow and temperature. I mean, and that's been testified
18 to by Lightning Dock. You know, those are the two
19 really important parameters. If you lose temperature or
20 flow, both of them can be detrimental to the operation.

21 MR. LAKINS: I tender Mr. Hand as an expert
22 witness in fluid dynamics, geothermal resource analysis,
23 and power plant design.

24 COMMISSIONER CATANACH: Any objection?

25 MS. HENRIE: Not from us.

1 COMMISSIONER CATANACH: Mr. Hand is so
2 qualified.

3 Q. Mr. Hand, if you could please give us an overview
4 of what --

5 MR. BRANCARD: Mr. Lakins, should we accept
6 Mr. Hand's resume as an exhibit before you go on?

7 MR. LAKINS: I tender Mr. Hand's resume as
8 our Exhibit W. Thank you.

9 MR. BRANCARD: Any objections?

10 (No verbal response.)

11 COMMISSIONER CATANACH: Exhibit W will be
12 admitted.

13 (AmeriCulture Exhibit W was offered and
14 admitted.)

15 Q. Mr. Hand, could you kind of give us an overview
16 of what you did in preparation for your testimony here
17 today.

18 A. Yes. In preparation for the testimony today, I
19 reviewed the public available documents about the Animas
20 Valley and then specifically about the Lightning Dock
21 Geothermal resource.

22 I also reviewed a DOE funded project, that was
23 primarily done by Barber-Nichols, to design and -- to do
24 the preliminary design of an organic Rankine cycle for
25 AmeriCulture.

1 Q. You were here and listened to the testimony at
2 the prior hearing, correct?

3 A. Yes. I listened to the previous testimony in
4 this case, and I've reviewed that testimony.

5 Q. Mr. Hand, are you prepared to offer an opinion
6 today?

7 A. I am.

8 Q. And could you summarize what that opinion is?

9 A. Yes. In my review -- and I think this study was
10 also used by Lightning Dock or Cyrq -- but the study was
11 by Johnson and it was for the state engineer office and
12 it was on the Animas Valley water flow.

13 And Mr. Johnson came to the conclusion that the
14 recharge in the Animas Valley was 13,000 acre feet per
15 year.

16 When you review Cyrq's proposal, they propose to
17 produce and inject 19,357 acre feet of water. So as an
18 engineer, I look at this, and I say, Well, you know,
19 what is the magnitude of this or what are the
20 possibilities?

21 And for me, I struggle with how this could not
22 have a large impact. I mean we are cycling 150 percent
23 of the recharge rate of the entire Animas Valley. And
24 if I understood the testimony by Lightning Dock, it is
25 that there would be very minimal impact.

1 And I just -- that's very difficult to believe.
2 Could you put this up?

3 Q. Sure.

4 A. This is a spacial layout. And so on the left,
5 the red well is the production well. And everything is
6 size relative. And so the scale matters on this.

7 So they're injecting -- you can see that bottom
8 piece down there where they are producing, it starts
9 around 1,600 feet, I believe, and then down to the
10 bottom of the well, which is around 2,900 feet.

11 And then the injection currently is in this long
12 blue well. And this one well represents both of the
13 wells they're trying to inject into. And the injection
14 level runs, as shown on the graph, from a little over
15 1,000 feet down to the bottom, which is around
16 4,200 feet.

17 And their proposal now is over -- it is further
18 away from the injection well. And so all of these wells
19 aren't in the same direction. But there's a clump of
20 three of them that around are 800 feet away -- 1,800
21 feet away. And then the last one is in the realm of
22 2,200 feet away.

23 And so if I understand what is proposed, it is to
24 inject into the shallow aquifer and this water is
25 somehow going to find its way back down to the deep

1 geothermal system.

2 Q. Do you agree with that?

3 A. No.

4 Q. Why not?

5 A. As you go deeper, by testimony of Dr. Miller, the
6 hydraulic conductivity decreases. And that is a general
7 rule. So if you go deeper, you need to find some
8 fractures.

9 And one of the board members asked the question,
10 Why don't you just drill into the fractures?

11 I don't think this water is going to find its way
12 back down to the deeper geothermal system unless there
13 is some hydraulic conductivity. Dr. Miller stated, he
14 referred to Darcy's Law, and he says that the recharge
15 going back down deep is entirely dependent on head. And
16 that can be calculated.

17 He said you can calculate on the basis of head
18 differential what amount of flow could possibly escape.

19 Q. Do you agree with that?

20 A. No.

21 Q. Why not?

22 A. Darcy's Law has not just head in it, but it also
23 has hydraulic conductivity. And if there's no hydraulic
24 conductivity, it's like a plugged pipe. I don't care
25 what the head is, you're not going to force flow to go

1 down there unless there's hydraulic conductivity.

2 I mean, just looking at this big picture, we are
3 going to stir up 150 percent of the recharge rate. And
4 we expect this to find fractures somewhere. We don't
5 know where they're at, but the water is going to find
6 them. And it is going to find its way due to the
7 drawdown in the head.

8 And so Darcy's Law is K equals IA . And the K is
9 the hydraulic conductivity. The I is the amount of
10 head. If one of those is close to zero, it doesn't
11 matter what the other one is. You are going to get very
12 little flow.

13 So I think there is a very high probability that
14 once the water gets out of the alluvial aquifer, that
15 the permeability is going to change; and, in fact, in
16 order to use Darcy's equation -- this is a very
17 anisotropic medium for flow, in other words, the flow --
18 in the alluvial plane, it's easy for flow to go vertical
19 or horizontal. But as you get beyond that, then you
20 have different layers and those have different
21 conductivity.

22 I'm not a geologist to tell you what those layers
23 are. But once those layers are presented, then it's a
24 matter of arithmetic to figure out what the conductivity
25 is.

1 And I have seen nothing in any testimony that
2 gives me any faith that this water is going to find its
3 way down to the deeper system before it's swept away by
4 the natural northwest trending of the ground flow in
5 this region.

6 And so -- I mean I think the testimony was, Well,
7 the plume might grow a little bit. Well, if you inject
8 150 percent of the annual recharge rate, I think it is
9 going to grow by more than just a little bit.

10 And I think it is very likely that more than a
11 few wells will be impacted by this. In fact, I don't
12 see how the whole Animas Valley is not impacted by it.

13 One of the claims has been that this is a closed
14 geothermal system.

15 Q. Speak to us about that. What is a closed system
16 in your mind?

17 A. This bottle is a closed system. The air in that
18 bottle is a closed system. There's no flow going in and
19 no flow going out.

20 And from an engineering perspective, mass is
21 conserved and -- I mean, it was stated that mass is --
22 that mass in equals mass out.

23 That is not a closed system. That's an open
24 system. You get mass flowing in and the mass flowing in
25 is going to have different properties or can have

1 different properties than the mass flowing out.

2 But it's worse than just flowing in and out. It
3 is different on the top. It is different on the bottom,
4 where supposedly the geothermal flow is coming in.

5 This could be modeled, but we haven't seen a
6 model, and I --

7 Q. What would you expect or what would you utilize
8 data-wise to compile a model that would demonstrate the
9 concept of the water being injected and returning back
10 down to the production? Do you understand my question?
11 That is kind of a bad question.

12 A. I got it.

13 Q. Okay.

14 A. The way I would model it is I would first start
15 from the drill logs and try to identify what layers of
16 subsurface we have, especially below the alluvial
17 aquifer, because that's where you're going to get into a
18 lot of anisotropy where the flow -- I mean, if you
19 pull on this supply well very hard -- and let's say that
20 the drawdown is 1,000 feet, if there is no hydraulic
21 connectivity to that alluvial aquifer where you are
22 injecting, the water is not going to go there.
23 I mean, you were told by Dr. Miller that it depended
24 entirely on the head, and that is absolutely false.

25 Q. Would it be possible to assemble a model?

1 A. Yes.

2 Q. One of the things that has been testified to is
3 that there is mounding -- is that there is an increase
4 in the water levels surrounding the monitoring wells; do
5 you recall that?

6 A. Yes.

7 Q. What does that tell you about the hydraulic
8 connectivity?

9 A. It tells me there is not much hydraulic
10 connectivity.

11 Q. Why is that?

12 A. Well, the theory is that when you draw down in
13 the production well that your injectors are going to see
14 it. But if they are mounding, I mean that means that
15 they're not -- there's more water being injected than is
16 being absorbed, and it's definitely not going down.
17 It's probably spreading out. Not "probably," it is
18 spreading out.

19 I mean, when you see it mound, that means the
20 size of the injection ring is going to grow.

21 Q. Another aspect of Dr. Miller's testimony had to
22 do with the percentage, 81 or --

23 A. True.

24 Q. Do you recall that testimony?

25 A. Yes. Early in Dr. Miller's testimony, he said

1 that there were 18 orders of magnitude difference in
2 hydraulic conductivity found in nature. And he said
3 only one hydraulic order of magnitude difference in
4 hydraulic conductivity would cause a diversion of
5 flow -- let's say that you had one that was the order of
6 ten and one that was an order of 100. Well, the 100
7 hydraulic conductivity would get 81 percent of the flow
8 and 19 percent of the flow would go the other way.

9 I mean if that's true, the hydraulic
10 conductivity, again by what Lightning Dock has
11 testified, they know that it's high in this alluvial
12 aquifer. We don't know what it is in the subsurface.

13 And, so, you know, to me making a decision on
14 this is like, you know, closing your eyes and hoping for
15 the best.

16 This can be modeled. This is not -- I mean, it
17 is complicated because you need data to model it. But
18 it is not complicated to get started. And there's --
19 you know, Dr. Miller said that he had done a back of the
20 envelope calculation. I mean, this is the state of New
21 Mexico. You are about to make a decision. I mean I
22 have doubt.

23 Q. Do you have an opinion as to whether or not water
24 injected up here at 150 to 500 feet has a likelihood of
25 making it down to the production zone based upon the

1 unknown hydraulic conductivity?

2 A. Yes.

3 Q. What is your opinion?

4 A. Yes.

5 Q. That it will make it or it won't make it?

6 A. You know my fear is it will not make it and that
7 you are going to put this geothermal brine in your local
8 aquifer that's used for lots of purposes.

9 Q. That's up here where the shallow injection would
10 be?

11 A. Yes. There has been no hydraulic path identified
12 for the water to get from that alluvial aquifer to that
13 deep geothermal aquifer. The only way it can get there
14 is by head, and that's only part of the picture.

15 Q. In your work with DOE, did you prepare models
16 that would be similar to the task that could be
17 accomplished here?

18 A. I didn't do that with DOE. I did that with the
19 geothermal power plant in Oregon. I did that with a
20 producer/injector/payor in Idaho.

21 Q. And what kind of data do you need, subsurface?

22 A. You need to know where the faults are. That is
23 really what you are looking for in the subsurface. And
24 you need to know what layers and their consistencies.
25 You need the hydraulic conductivity.

1 And it is not just a simple Darcy's Law. It's a
2 Darcy's Law that is split into at least three
3 directions. And, you know, if I put it out here
4 mathematically, it is complicated; but conceptually,
5 it's pretty simple, that the water is going to take the
6 easiest path to neutralize itself, you know, all head is
7 going to try to neutralize itself.

8 And so, like Dr. Miller said, if it's an order of
9 magnitude better permeability in this alluvial aquifer
10 than it is deep, then 81 percent of the flow is going to
11 be up there in that aquifer.

12 I mean, I think this is, you know, something that
13 should be looked at very intently; and, you know, I mean
14 a back of the envelope calculation?

15 Q. Let's switch to a different topic.

16 A. Sure.

17 Q. Are you aware of AmeriCulture's planned
18 construction of a small scale geothermal electric power
19 plant?

20 A. I am.

21 Q. Tell us what you know.

22 A. AmeriCulture hired Barber-Nichols to do the
23 preliminary design on a power plant that they could use
24 internally for their own power and that would serve them
25 well for their planned growth.

1 And the resource temperature that they found was
2 232 degrees Fahrenheit. And with that temperature,
3 Barber-Nichols designed a power plant -- actually,
4 similar to one that's organic Rankine cycle, a little
5 bit different expansion device, but, basically, the same
6 technology. And the net output would be about one
7 megawatt.

8 And, you know, I was asked to look at, Well,
9 let's imagine that through this injected water at
10 170 degrees -- which is about what Lightning Dock
11 reported their injection temperature is -- if that mixed
12 with the 232-degree water, what could the possibilities
13 be?

14 So I assumed a 20-degree loss. And if you look
15 back and use the same linear mixing model that was used
16 by Dr. Miller, you need about 32 percent of the
17 172-degree water to mix with the remaining water that
18 would be at 132, and that would drop it to 212 degrees.

19 Well, a 20-degree drop at those low temperatures
20 would probably compromise your power by at least
21 25 percent. So having a power plant at a megawatt now,
22 you have 750 KW.

23 And if you look at that power plant and you
24 assume that the electricity is worth ten cents a
25 kilowatt hour and you prorate that over 30 years, the

1 present value of that is \$12.2 million. So that's a
2 significant amount of harm.

3 And, again, this assumes a 32 percent mixing
4 ratio. And I've got to think that's low because the
5 19,000 acre feet that they're going to pull up and put
6 in this alluvial aquifer again is 150 percent of the
7 recharge rate. So it is a big impulse that they're
8 putting on this system.

9 And since you have a lower temperature, your
10 power plant now needs larger heat exchangers, larger
11 blades on your turbine, and it's going to cost probably
12 \$5 million instead of \$4 million, which is another
13 million dollars of cost.

14 So I would estimate the harm to AmeriCulture of a
15 drop of 20 degrees Fahrenheit in their resource
16 temperature to be \$13.2 million.

17 Q. Mr. Hand --

18 A. There's one other item.

19 Q. Go ahead. Sorry.

20 A. Dr. Miller's testimony indicated that
21 AmeriCulture was diluting its own well, causing harm to
22 it by their injection routine. And the amount of
23 injection in that particular well was ten acre feet a
24 year.

25 And it seems to me to be a great, you know,

1 disjointedness for you to say that ten acre feet has
2 this big impact and you are going to do 19,000 acre feet
3 and the impact is going to be minimal. I mean, I don't
4 see how you used the same science to reach this
5 conclusion and you come over here and you have two --
6 three orders of magnitude greater injection and you're
7 not going to have any impact.

8 I just -- again, a lot of what I do is big
9 picture stuff. It just doesn't add up.

10 Q. I'm going to show you, Mr. Hand, what is
11 AmeriCulture's Exhibit R. You don't have that over
12 there. But I want you to kind of run down this slide
13 and tell me, is this sort of the calculation that
14 summarized the testimony --

15 A. Yes.

16 Q. -- for the potential financial loss --

17 A. Yes. So you start with 232-degree geothermal
18 water when you're producing a megawatt. And you have to
19 make some assumptions about the mixing rate of the
20 water. And as I said, I think I'm low on this. I
21 assume 20 degrees. But if they really injected this
22 19,000 acre feet a year number, I think that the ability
23 for AmeriCulture to have a power plant is probably mute,
24 because I think that the mixing -- I mean, Darcy's Law
25 is not a mixing thing. The fixed law of diffusion is

1 something that ought to be used here in this model.

2 So the power plant efficiency is reduced. And
3 the way I got at that is I took Barber-Nichols' numbers
4 for the power plant and I used a power plant that is
5 working on the organic Rankine cycle at the Oregon
6 Institute of Technology. I used their numbers on what
7 they're doing.

8 And when I assume a straight line, again a
9 proration, the same sort of mixing strategy that you
10 have seen presented before, I find that the efficiency
11 would drop from a little over 7 percent to a little over
12 5 percent. And that is where you get the 25 percent
13 reduction.

14 And the rest of the things here are just
15 arithmetic. You are going to need bigger heat
16 exchangers. And it's going to cost you more to build it
17 initially. And you're going to get less out of it over
18 the 30 years.

19 Q. I am going to turn to the second page of that
20 document. And could you speak to the information that
21 is on that second page that's up here.

22 A. That's true.

23 Q. No. Could you explain that, please? This kind
24 of summarizes your testimony.

25 A. Yes. I mean, the quantifiable harm here is that

1 he will be able to produce less power and the power
2 plant is going to cost him more; a drop of 250 KW, and
3 over 30 years that amounts to the 12.2 million. And the
4 power plant is going to cost approximately a million
5 dollars more to build, because it's lower temperature
6 and you need bigger stuff, bigger heat exchangers,
7 bigger turbine to convert that to power.

8 MR. LAKINS: I move to admit Exhibit R.

9 COMMISSIONER CATANACH: Any objection?

10 (No verbal response.)

11 MR. BRANCARD: Mr. Lakins, could you
12 establish who created Exhibit R?

13 Q. Mr. Hand, did you create these slides?

14 A. Yes.

15 MR. ROGERS: Exhibit R, no objection.

16 COMMISSIONER CATANACH: Exhibit R will be
17 admitted.

18 (AmeriCulture Exhibit R was offered and
19 admitted.)

20 Q. Mr. Hand, do you have any further thoughts on
21 this project, further opinions?

22 A. The only other thing that I would add is -- I
23 mean, it is a decision, but, I mean, I think when you
24 look at the potential harm and the kind of back of the
25 envelope reference and hand waving and lack of a model,

1 I mean, it just gives you pause.

2 Q. Turning back to your spacial layout, the current
3 production in injection is almost being utilized; is
4 that accurately portrayed --

5 A. Yes.

6 Q. -- in this spacial layout?

7 A. Yes.

8 Q. Did you create this?

9 A. Yes.

10 Q. And does it accurately portray the distances at
11 600 feet up there as the known distance between the
12 production injection?

13 A. Yes.

14 Q. And the 18,000 and 25,000 feet, that's the
15 proposed distance --

16 A. Yes.

17 Q. -- for the four proposed --

18 A. Yes. That's a proportional diagram. I mean, it
19 helps me to try to visualize what we're talking about
20 and without a lot of clutter in it. I mean, you would
21 have to have really good connectivity -- I mean, the
22 proposal is we are going to move further away and we are
23 going to inject into an aquifer that has high
24 permeability and that water is going to somehow find its
25 way back to the geothermal reservoir.

1 I mean, I have no doubt they can inject in that
2 alluvial aquifer, no doubt in my mind at all. But it
3 getting back and not causing harm is where the doubt is
4 at.

5 Q. Do you have an idea of what could be done to
6 actually accomplish production and injection in keeping
7 it within that lower zone; do you have any ideas?

8 A. Yes.

9 Q. What's that?

10 A. If you drilled wells and you found these
11 fractures and there were some aquitard between where
12 you're injecting and the ground water aquifer, I think
13 that would solve the issue.

14 Q. Drill deeper?

15 A. Yes.

16 Q. Drill closer to the current production well?

17 A. You know, you are asking me a geology question --
18 I mean, a lot of this does reduce down to a fluids
19 problem. I mean, where is this water going to go?

20 Darcy's Law, I mean, there's wrong with the law,
21 but fluids is a lot more complicated than Darcy's Law.

22 Darcy's Law is a special subset that you use to
23 describe laminar flow. What's going on around these
24 injection wells in the immediate vicinity is probably
25 not laminar flow. There's a lot of mixing. Laminar

1 connotes there's no mixing.

2 And then we have flowing through this in the
3 alluvial aquifer -- and, you know, what's been described
4 as their closed system, it's just not a closed system.
5 You have, you know, Dr. Miller's words again, Mass in,
6 and you have, Mass out.

7 And it's not just in here and in here, but it's
8 in all over the place. I mean, he described how the --
9 you know, the upflow mixes. That's going to go on.

10 And Darcy's Law is just not appropriate to
11 describe that kind of situation, especially not in a
12 one-dimensional isotrophic form.

13 MR. LAKINS: I move to make Mr. Hand's
14 spacial layout, visual aid, our Exhibit X.

15 COMMISSIONER CATANACH: Do you move to admit
16 that?

17 MR. LAKINS: Yes, sir.

18 COMMISSIONER CATANACH: Any objection,
19 please?

20 MR. BRANCARD: I guess I have an objection.
21 Can I ask the witness some questions about his exhibit.

22 EXAMINATION BY MR. BRANCARD

23 MR. BRANCARD: On the two wells you have on
24 the left, you have a production zone and an injection
25 zone, a top and a bottom of the zone.

1 On the wells on the right, you just have the
2 top of the zone, correct?

3 THE WITNESS: No. It's actually too small
4 to show it in the scale way.

5 MR. BRANCARD: Did you look at the
6 applications that indicate what their injection zones
7 are supposed to be.

8 THE WITNESS: I haven't looked at their
9 application. It is my understanding they are between
10 150 and 500 feet.

11 MR. BRANCARD: The top?

12 THE WITNESS: My understanding, the top is
13 150.

14 MR. BRANCARD: So you didn't know what the
15 bottom of the injection zones were when you drew these?

16 THE WITNESS: I --

17 MR. BRANCARD: I mean, they are your
18 exhibits, Mr. Lakins, that have the applications that my
19 reading is the bottom of the injection zone for each one
20 of these is 1,500 feet. And I don't see 1,500 feet
21 being shown on this.

22 So the answer to Mr. Lakins' question, "Is
23 this an accurate portrayal," is I have a real concern,
24 Mr. Chairman, that this is not an accurate portrayal.

25 THE WITNESS: If the bottom injection is

1 1,500 feet, it's not.

2 MS. HENRIE: Mr. Chairman, we share that
3 objection. Mr. Hand admitted he is not a geologist and
4 yet we have a description of the alluvium at a certain
5 place, of clay, limestone -- clay? Where's the clay? I
6 don't know where this description came from.

7 THE WITNESS: I thought three of the
8 injectors were 500 feet and one of them was deeper,
9 which is what I have shown. That's not the case?

10 MR. BRANCARD: I was just reading your
11 Exhibit M.

12 COMMISSIONER CATANACH: Which exhibit are
13 you looking at?

14 MR. BRANCARD: I am looking at Exhibit M,
15 which I believe are the form applications for the
16 injection wells.

17 COMMISSIONER CATANACH: On AmeriCulture's
18 exhibits?

19 MR. BRANCARD: Yes.

20 MS. HENRIE: Mr. Chairman, if these forms
21 are not something that you studied before, up towards
22 the top, it has casing and tubing data. And it says,
23 name of string size, setting depth. And you can see the
24 setting depth down to 1,500 feet.

25 COMMISSIONER CATANACH: I believe that these

1 show that the injection interval, the top of that zone
2 is 150 down to 1,500 feet, is what we're showing?

3 MS. HENRIE: Yes, Mr. Chairman. The wells
4 have not been drilled. We don't know what we will find.

5 COMMISSIONER CATANACH: So it doesn't appear
6 that the exhibit doesn't correctly show what the
7 injection interval is in those proposed wells.

8 MR. BRANCARD: Mr. Chairman, my other
9 concern is there is this black line across here
10 referring to the 'Allivum," Good hydraulic conductivity
11 at 600 feet. I don't know that we've had any testimony
12 about the 'allivum.'

13 COMMISSIONER BALCH: Dr. Miller did testify
14 about the alluvium.

15 COMMISSIONER CATANACH: Mr. Lakin, is there
16 going to be a witness that can clarify some of these
17 geologic issues on this exhibit?

18 MR. LAKINS: Yes, sir. I will just withdraw
19 that request for admission of that exhibit at this time.

20 COMMISSIONER BALCH: If you are going to
21 readmit it later, could you add the correct depths to
22 the wells?

23 MR. LAKINS: Yes, sir.

24 COMMISSIONER CATANACH: Okay.

25 MR. LAKINS: I pass the witness.

1 MS. HENRIE: Do you have questions?

2 MS. MARKS: May I just ask a few questions
3 first?

4 COMMISSIONER CATANACH: Yes.

5 CROSS EXAMINATION

6 BY MS. MARKS:

7 Q. Dr. Hand, I just want to ask a few questions.
8 I'll be very quick. The proposed -- the plant that you
9 were talking about losing 20 degrees, this is
10 AmeriCulture's future power plant; is that correct?

11 A. Yes.

12 Q. I remember -- and I'm going to be -- certainly
13 have not memorized the exhibits very well. But I think
14 they apply or they mention this power plant back in I
15 think in 2002 or so.

16 I know -- thank you, obviously, for your service.
17 Have you -- do they have a permit with the State Land
18 Office? Do they have all the requisite documents to
19 build this power plant? Do they have the contracts,
20 all the needed documents? I don't know...

21 A. Are you asking me if it's permitted?

22 Q. Can they build this power plant. You talked
23 about this potential harm. I don't know that they
24 actually can build this power plant. Do you know in
25 your analysis that they actually can build this power

1 plant?

2 A. Yes, they can build this power plant.

3 Q. What is your basis for them having all the state
4 requirements -- that they met all state requirements to
5 build this power plant? Can you talk about that?

6 A. They have not met all the state requirements to
7 build the power plant. There would be construction
8 permits that have to be pulled, they would have to have
9 an agreement with the utility about how they are going
10 to interconnect if they do. So they haven't done that,
11 no.

12 Q. Do they need to meet certain requirements with
13 the State Land Office as well?

14 A. Excuse me. Say that again.

15 Q. Must they meet certain requirements with the
16 State Land Office as well?

17 A. Yes.

18 Q. And have they done that?

19 A. Yes.

20 Q. Okay. What is the basis that they can build the
21 power plant?

22 MR. LAKINS: Objection, vague. I don't
23 understand the question.

24 MS. MARKS: I am really confused as to all
25 this potential loss that Dr. Hand has spoken of. I

1 don't really understand -- I mean there's a number of
2 records that -- preliminary steps that must be taken.

3 And Dr. Hand has testified about this
4 potential harm. And I am not really sure that
5 AmeriCulture has taken all the necessary steps to be
6 able to build a power plant.

7 MR. LAKINS: If I may, that will all come
8 out from Mr. Seawright. We put Mr. Hand on first, kind
9 of a little out of sequence, primarily because he has to
10 leave and he was here before, for two days and he didn't
11 get to testify and he needs to leave. So we put him on
12 first.

13 But all those questions that you have,
14 Ms. Marks, about the permitting, et cetera,
15 Mr. Seawright would be the perfect one to answer all
16 that.

17 MS. MARKS: Okay. I think the extent of the
18 harm, the two are interrelated so...

19 MR. LAKINS: I agree.

20 MS. MARKS: I'll save the questions then
21 that are related to the power plant, so...

22 THE WITNESS: Okay.

23 MS. HENRIE: Passing?

24 MS. MARKS: Sure.

25 CROSS-EXAMINATION

1 BY MS. HENRIE:

2 Q. So, Mr. Hand, you're not a reservoir engineer; is
3 that --

4 A. No.

5 Q. And not a geologist, either?

6 A. No.

7 Q. So you talked about I believe a one-megawatt
8 power plant. Is that one megawatt net or gross?

9 A. Net.

10 Q. And so what is the flow rate that is going to be
11 needed to get one megawatt out of this resource?

12 A. The flow rate which Barber-Nichols used was
13 around 1,000 GPM.

14 Q. And do you know when Barber-Nichols made this
15 analysis or report?

16 A. I don't remember the date on the study. But I
17 think it was -- it had to be after 2007. But I don't
18 remember the date on the study.

19 Q. So maybe ten years ago?

20 A. No, it was not ten years ago.

21 Q. But it wasn't this year?

22 A. No.

23 Q. Do you know what's been done since 2007 or
24 whenever the Nichols' study --

25 A. Do I know what?

1 Q. What's been done by AmeriCulture to effect this
2 power plant since the Nichols' report?

3 A. My only involvement is they're trying to protect
4 their interest that they have building this power plant
5 from being harmed by the company you're representing.

6 Q. And that's it --

7 A. That's my involvement.

8 Q. -- just harassing us?

9 MR. LAKINS: Objection.

10 A. You can ask them.

11 MR. LAKINS: Objection to the statement
12 "harassing." That wasn't a question. That was a
13 characterization.

14 COMMISSIONER CATANACH: Let's try to refrain
15 from that, Ms. Henrie.

16 MS. HENRIE: Yes, sir. Yes, sir.

17 Q. You talked a little bit about your experience
18 with geothermal, including for Zia Pueblo, I believe.
19 Did you do geothermal on that project or did Mr. Witcher
20 do the geothermal?

21 A. Mr. Witcher did the geothermal; I did the power
22 plant analysis.

23 Q. And have you done any analysis for AmeriCulture
24 as whether it would be more cost effective to use solar
25 instead of geothermal for its power generation?

1 A. No.

2 Q. And do you have any experience operating
3 geothermal power plants?

4 A. No.

5 Q. So when you talk about the cost of power, does
6 that include operations and maintenance of the
7 geothermal power plant in those numbers that you gave
8 us?

9 A. Yes.

10 Q. It does.

11 A. The ten cents is from the rate of Columbia Power,
12 and it includes all their O and M and all their cost of
13 operating.

14 Q. For the utility power? If they buy the power off
15 the grid, it includes the cost of O and M?

16 A. Yes.

17 Q. But if it's geothermal power -- and I think you
18 told us -- but I don't letter the number -- does that
19 include O and M costs?

20 A. Yes.

21 Q. So how did you estimate those costs, not having
22 actually operated a geothermal power plant?

23 A. I estimated those costs for several entities. I
24 actually -- the ten cents is a number that is what
25 people refer to as a lifecycle cost. And it includes

1 everything that you have to do to put power on the grid.

2 So I did not dissect it out to, this is O and M
3 and this is cost of equipment, et cetera.

4 Q. Is there any relationship between the circulating
5 rate and the recharge rate?

6 A. I don't know what you're trying to ask me.

7 Q. You talked about recharge into the Animas Valley.
8 And I think you based that on a document by Johnson, a
9 state engineer document by Johnson?

10 A. Yes.

11 Q. Is that your only source for that information?

12 A. It is the only one I reference. There were
13 several sources that Johnson referenced that have a
14 similar number.

15 Q. Did you have a chance to review Mr. Witcher's
16 2002 pumping test? There's a report that we included in
17 our exhibits. Did you have a chance to look at that?

18 A. Yes.

19 Q. And have you looked at the Shomaker 2012 report?

20 A. Yes.

21 Q. And can you talk a little bit about comparing
22 those two pumping tests, what they teach us about the
23 resource?

24 A. I can't compare them. I'm not a geologist. I
25 mean, they both make allegations -- I mean, where I can

1 help at is when you get down to flow and you're applying
2 a fundamental equation, I can tell you whether you're
3 applying appropriately, whether your expectations are
4 reasonable; but the geology, that's not my expertise.

5 Q. Okay. What about transmissivity, can you define
6 that for me?

7 A. In general, transmissivity is the flow of water
8 through an aquifer. And I don't remember the units, but
9 it is a property that's associated with the water in the
10 medium that it's flowing through.

11 Q. And I think you characterized Dr. Miller's
12 testimony as 18 orders of K. Could that have been 13?

13 A. It could have been. 13 orders of magnitude --
14 whether it is 13 or whether it is 18, you know -- it is
15 in the testimony, so there should be no ambiguity about
16 that.

17 13 orders of magnitude is a lot. One order of
18 magnitude is a lot, too.

19 Q. Have you heard about or reviewed the ground water
20 mining which took place in the Animas Valley? That came
21 up in one of the prior testimonies, that there was
22 ground water mining --

23 A. Yes.

24 Q. You're familiar with that?

25 A. Yes.

1 Q. What is the significance of mining with regard to.
2 recharge?

3 A. You are asking a question I don't know the answer
4 to.

5 Q. Fair enough.

6 You said that this resource could be modeled and
7 you haven't seen a model. How would you go about
8 modeling the resource?

9 A. I would first try to estimate what the hydraulic
10 conductivity is between where I am injecting and where
11 I'm producing. I mean, your expert witness told us that
12 the head was going to pull it down and he referenced
13 Darcy.

14 And Darcy has two terms in it. One of them is
15 head and one of them is hydraulic conductivity. This is
16 also very anisotropic. So I wouldn't use the simple
17 form of Darcy's Equation nor back of the envelope
18 calculations.

19 Q. And you think we have done back of the envelope
20 calculations?

21 A. From Dr. Miller's testimony, that's how I know.

22 Q. Have you ever used Darcy's Law in a geothermal
23 calculation?

24 A. No.

25 Q. I also wanted to clarify this. I think you

1 characterized the effluent from the AmeriCulture
2 facility as ten acre feet; do you recall that?

3 A. I didn't characterize that. I quoted that from
4 Dr. Miller's testimony.

5 Q. So just to have the record clear, this is page
6 133 of Dr. Miller's testimony, lines 6 through 11. And
7 he says, "I have observed that ten, 15 acre, possibly
8 20 acre feet for your hot water are produced, and
9 between 100 and I think the peak number was 175 acre
10 feet for your cold water produced."

11 So I think that's really different than ten acre
12 feet. I just wanted to make that clarification.

13 A. Okay.

14 Q. All right. You talked about modeling. Have you
15 any experience in geothermal resource modeling?

16 A. I do.

17 Q. You do. How about ground water modeling?

18 A. I don't.

19 Q. No. Just geothermal. Okay.

20 I thought I heard you characterize what's being
21 reinjected as geothermal brine. Are you able to
22 characterize that brine?

23 A. "Brine" is a generic term that is used to refer
24 to geothermal fluid. I mean it doesn't bother me if you
25 call it "fluid" or if you call it "water," but it's

1 geothermal and it is deep and it is different than the
2 water in the local aquifer.

3 Q. So it is not necessarily briny? That term
4 doesn't --

5 A. "Brine" is a term that's used in the industry.

6 Q. Okay. Did you say that there was no hydraulic
7 path from valley fill aquifer to the geothermal aquifer?

8 A. I said there has been none identified.

9 Q. None identified, okay.

10 Do you know if the waters of the valley fill
11 aquifer within the area of the geothermal system are
12 hot?

13 A. Ask me that question again.

14 Q. In the area of the geothermal system where
15 the greenhouses and the power plants are, do you know if
16 the valley fill is hot in that area?

17 A. Well, to start with, I don't know what the
18 geothermal system is because it's not been defined, and
19 so I can't answer your question.

20 Q. Dr. Shomaker defined it.

21 A. The reference I have is that it is a closed
22 system. It's not a closed system. And so -- I mean,
23 this hand-waving stuff where you defined it is just not
24 adequate.

25 I mean, we have a map up there, but the

1 geothermal system is not outlined. I have seen some
2 maps of plumes. But still I don't see where the
3 geothermal system is at. I don't see the mass coming
4 in. I don't see the mass going out. And there's a lot
5 more locations where mass is coming in and where mass is
6 going out than has been shown in these simplistic
7 diagrams. So I don't know what this geothermal system
8 is.

9 Q. Okay. And speaking about mass coming in, when
10 Johnson cites a certain mass coming into the Animas
11 Valley, does that include the geothermal mass that is
12 coming in?

13 A. That is recharge.

14 Q. That is recharge. So the geothermal mass is
15 separate --

16 A. Again, that's a geology question. I mean, it is
17 coming into the valley as recharge.

18 Q. Okay. So when you say that -- I think you said
19 Lightning Dock is going to be producing and reinjecting
20 about 19,000 acre feet. Where do you get that number
21 from?

22 A. I got it from one of the applications filed with
23 the state. But the actual number is 19,357 acre feet.

24 Q. So that would have been a State Engineer
25 application that was withdrawn perhaps?

1 A. I don't know if it was a State Engineer
2 application or an OCD application. But it was one filed
3 by Lightning Dock.

4 Q. And it stated a rate in terms of acre feet, as
5 opposed to gallons per minute --

6 A. It had 19,137 in it.

7 Q. Okay.

8 A. It calculates out to 12,000 GPM.

9 Q. Okay. And is that what the proposal is now,
10 12,000 GPM?

11 A. I don't know what your proposal is. I have heard
12 testimony that it's 7-1/2 times the current rate. I
13 have seen your documents that say you are producing
14 around 1,600 GPM now.

15 It is a big number, and my whole point is you are
16 talking about a big impulse to the system. That's not
17 insignificant. It is something that gives me pause.

18 I mean, if the State Engineer called me and asked
19 me as a mechanical engineer, I would definitely be
20 concerned.

21 Q. But you are not a reservoir engineer?

22 A. I am not. But what you are doing up here is not
23 in the reservoir, either. It's up here in the alluvial
24 aquifer.

25 Q. And can you explain the effective pressure and

1 head on a production well and an injection well?

2 A. Can I explain what?

3 Q. The relationship or the effects of pressure and
4 head as between an injection well and a production
5 well?

6 A. Well, pressure and head are the same thing, so I
7 don't understand.

8 Q. What I understood you to say is that despite the
9 cone of depression, despite the injection pressures,
10 despite all those things, you don't believe that a
11 shallow injection will get back down to the production
12 well or that at least -- you don't see that happening?

13 A. No, I don't see that happening.

14 Q. And so is there any effect at all on the cone of
15 depression?

16 A. By "cone of depression" I take it you mean what's
17 happening at the production level.

18 Q. Sure.

19 A. So that cone of depression is going to cause more
20 water to flow in. Now, where that water comes from is
21 going to be determined by the difference in head and
22 where that's occurring and also the hydraulic
23 conductivity.

24 And what was missing from testimony was the
25 hydraulic conductivity. There's not been a path that's

1 been shown. It's been hand waved at. But there is no
2 path.

3 And so if I have 300 feet of head, it doesn't
4 really matter. If you have no hydraulic conductivity,
5 then there is going to be no flow. It is like a flooded
6 pipe. I mean that's basic fluids.

7 Q. And were you here for Dr. Shomaker's testimony
8 about all the fracturing and the water is flowing in the
9 fractures?

10 A. Yes.

11 Q. And you don't consider that as part of the
12 hydraulic conductivity?

13 A. Where are the fractures at?

14 Q. So does a pumping test determine hydraulic
15 conductivity?

16 A. Just a pumping test alone does not.

17 Q. So how would you determine hydraulic
18 conductivity?

19 A. You would need at least two wells. I mean, the
20 way that Darcy did it was he isolated the system and he
21 put some head on it. And he found out that this
22 hydraulic conductivity was a function of the material.

23 And, actually, the hydraulic conductivity, as
24 Dr. Miller presented it, it actually has two
25 constituents. One of them is a property of the medium,

1 like gravel or alluvium or whatever you have, and the
2 other is a property of the fluid that's transmitting
3 through the medium. He is using a combined term. And
4 so you would need to know both.

5 You know, the rate, you need to know your
6 drawdown and your pumping rate, and then you can compute
7 an average hydraulic conductivity, depending on how well
8 you've isolated the system.

9 Q. So are you aware of the pumping tests that have
10 been conducted of this resource?

11 A. I am not.

12 Q. Can you do a single well test?

13 A. Say again.

14 Q. Can you do a single well test? You've described
15 more than one well.

16 A. Can you do a single well test for what?

17 Q. A pump test to establish hydraulic conductivity.

18 A. If you measure the drawdown and you measure the
19 flow rate, then you have drawdown plus you have flow
20 rate. And then the other variable that you can back out
21 of this is hydraulic conductivity.

22 Q. Okay.

23 (Pause.)

24 MS. HENRIE: Just a couple more questions.

25 Q. Mr. Hand, I think you said earlier that you were

1 familiar with both the Witcher pumping test in 2001, the
2 report from that test, I think you --

3 A. I was familiar with what?

4 Q. The pump test report from Mr. Witcher in 2001,
5 which is one of the exhibits in this proceeding.

6 A. I have read both the reports, the details, so,
7 yes, I am familiar with it. I would recognize it.

8 Q. And the Shomaker test from 2012, I believe you
9 said you were familiar with that as well?

10 A. Yes.

11 Q. And you don't feel that those say anything about
12 hydraulic conductivity?

13 A. I don't -- I mean, they didn't say anything that
14 registers with me. I don't remember.

15 Q. Okay. What I remember from your testimony is
16 that you have experience with maybe a half dozen
17 geothermal resources?

18 A. Yes.

19 Q. So five or six?

20 A. It is more like six to 12.

21 Q. Okay. And you mentioned the Zia Pueblo study.
22 Did anything get built from that?

23 A. No.

24 Q. And I think you mentioned Paisley Power?

25 A. Yes.

1 Q. Are they generating anything right now?

2 A. Yes.

3 Q. How much?

4 A. Three megawatts.

5 Q. Okay.

6 MS. HENRIE: We will go ahead and pass the
7 witness, Mr. Chairman.

8 MS. GAULT: Excuse me. Can I ask him some
9 questions?

10 MR. BRANCARD: Just a few.

11 MS. GAULT: Okay.

12 QUESTIONING BY MS. GAULT

13 MS. GAULT: I read the whole testimony from
14 the hearing in September. And I understand that they --
15 I want to know from you if you understand that the
16 reason that they cannot inject deep, like they promised
17 us, is because there is no hydraulic conductivity.

18 And I want to know if -- I don't recall
19 anybody in their testimony talking about hydraulic
20 conductivity. I do recall about pressure, head. That I
21 recall. I do not -- but now you are giving me an answer
22 maybe of why they cannot go to the deep reservoirs that
23 they are supposed to go, according to my understanding.

24 Another thing I wanted to ask you, I also
25 did not understand this closed route. There is

1 fractures there. There is fissures there. There is a
2 possibility that the water will go laterally. So where
3 is the closed loop?

4 So the hydraulic conductivity and the closed
5 loop are connected. If there was a closed loop, we
6 would have hydraulic conductivity? Can you -- I am just
7 not a very smart person and I am not a hydro geochemist.
8 Maybe if we had a hydro geochemist, he can answer this
9 about hydraulic conductivity. It was not in the
10 testimony.

11 THE WITNESS: You need both a flow path,
12 which is hydraulic conductivity, and you need some
13 pressure to push it along that way. And if you don't
14 have one of them, you have no flow.

15 And so -- I mean if you have mediocre
16 hydraulic conductivity and you have pressure head, you
17 combine them and you get mediocre flow. And I think
18 that's kind of what they have in the wells that they
19 have drilled. I mean, you need them both.

20 MS. GAULT: So, basically, I think this is
21 the answer for me as far as the conservation district,
22 why we don't get to the deep water. There is something
23 missing here. I don't know, maybe the model can find
24 out where is this hydraulic conductivity, can we -- if
25 we be closer to the production well, do you think you

1 will find out this hydraulic conductivity?

2 I don't understand if there is any reason
3 why they cannot go close to that. Is there any reason
4 why they cannot have the injection closer --

5 THE WITNESS: You are asking me a geology
6 question. As a hydraulic connectivity problem, you'd
7 want to be as close as possible. But then you inject,
8 you know, cooled-off water into your production well.
9 It's a difficult problem to solve. It's not easy.

10 MS. GAULT: Thank you, sir.

11 COMMISSIONER CATANACH: Go ahead, Dr. Balch.

12 EXAMINATION BY EXAMINER BALCH

13 COMMISSIONER BALCH: Good afternoon,
14 Mr. Hand.

15 THE WITNESS: Good afternoon. I'm trying
16 very hard to hear.

17 COMMISSIONER BALCH: I am also very
18 soft-spoken.

19 I don't think there is much of a question
20 that there has to be some hydraulic conductivity or
21 conductivity between the deep geothermal aquifer and the
22 shallow aquifer, because you have a geothermal anomaly
23 that's deep and also a shallow. So it has to be at some
24 level of connection.

25 THE WITNESS: Yes.

1 COMMISSIONER BALCH: Because that water is
2 what's moving the heat from deep to shallow.

3 THE WITNESS: The heat is moving the water,
4 and there has to be hydraulic connectivity for it to
5 move. That's true.

6 But it is all going up so. And so you would
7 be going against that density gradient that's already
8 established. So I mean -- I have no doubt there's some
9 hydraulic connectivity, but the question is is there
10 enough?

11 And I never thought about orders of
12 magnitude difference in hydraulic connectivity. But if
13 one order of magnitude causes an 81, 19 percent split
14 and this stuff in the subsurface, unless they get into a
15 fracture, it's at least an order of magnitude
16 difference -- I mean, just when you look at the tables
17 and the published numbers, orders of magnitude.

18 And to me that strongly suggests that you
19 are going to have at least 80 percent of whatever you
20 inject that stays up in this shallow aquifer. And I
21 think that would be detrimental.

22 COMMISSIONER BALCH: Well, they have four
23 wells that they propose with an injection depth,
24 maximum, of 1,500 feet in each of those wells. They're
25 going to have a maximum injection pressure as well.

1 THE WITNESS: Sir, I need you to back up. I
2 didn't catch what you said.

3 COMMISSIONER BALCH: All right. So these
4 four wells that are proposed, each of them has a maximum
5 injection depth of 1,500 feet and they also have -- I
6 presume there's going to be an associated maximum
7 injection pressure.

8 So if they drill the wells and they can't
9 get the fluids to go in at the rate that they predict,
10 they are going to have to do something else. Their hope
11 is they are going to connect to some of those
12 conductivity.

13 THE WITNESS: I think in these injection
14 wells, they're going to start perforating at 150 feet.

15 COMMISSIONER BALCH: That's what the
16 proposal is on some of them, yes.

17 THE WITNESS: And so if you do that --
18 again, it's this order of magnitude, thermal,
19 hydraulic -- not thermal, but hydraulic conductivity, if
20 that alluvium -- and not "if," I mean, it is permeable.

21 COMMISSIONER BALCH: So if the geology at
22 the base of the alluvium, which I presume Mr. Witcher is
23 going to show us later, is a barrier to flow, and all of
24 your perforations are below that, that should accomplish
25 what Mr. Lakins asked you?

1 THE WITNESS: Yes, I would agree with that.

2 COMMISSIONER BALCH: What would you do if
3 you Lightning Dock? You'd drill them deeper.

4 THE WITNESS: I mean, to make these systems
5 operate so you don't trash the local aquifer, you need
6 some sort of aquitard between where you're injecting and
7 that water.

8 COMMISSIONER BALCH: Did you find in any of
9 your public data search kind of a flow rate of that
10 Animas Valley aquifer to the north?

11 THE WITNESS: I did. But I don't remember
12 the numbers. It is in the Johnson report.

13 COMMISSIONER BALCH: Do you recall
14 approximate order of magnitude compared to the recycle
15 volume that we are talking about here?

16 THE WITNESS: I don't for the flow through
17 it. I mean, I think it is the same order of magnitude,
18 but I don't remember the number. I would have to look
19 it up.

20 COMMISSIONER BALCH: The Johnson report?

21 THE WITNESS: I mean, the number I keyed on
22 was the recharge rate, because that's the rate of fresh
23 water that essentially dilutes everything and keeps it,
24 you know, in the state it is in right now.

25 COMMISSIONER BALCH: Do you know at what

1 depth the 232-degree water for the AmeriCulture
2 Geothermal power wells is going to be coming from?

3 THE WITNESS: I don't remember the number.

4 COMMISSIONER BALCH: Okay. I think my other
5 question would probably be better answered by a further
6 witness. Thank you.

7 COMMISSIONER CATANACH: Go ahead,
8 Mr. Padilla.

9 EXAMINATION BY EXAMINER PADILLA

10 COMMISSIONER PADILLA: Good afternoon,
11 Mr. Hand.

12 THE WITNESS: Good afternoon.

13 COMMISSIONER PADILLA: Just a couple of
14 questions for you. The 13,000 acre feet from the
15 Johnson report, that's an OSE report -- I just want to
16 clarify that -- from the State Engineer?

17 THE WITNESS: Yes.

18 COMMISSIONER PADILLA: And you said that
19 that is the recharge rate listed in that report.
20 Lightning Dock proposes to use I guess -- this never --
21 it may be in dispute now -- but 19,000 per year for
22 their proposed operations?

23 THE WITNESS: Yes.

24 COMMISSIONER PADILLA: Given that that is
25 based on testimony in some sort of loop, whether closed

1 or not, depending on who is giving testimony, can you
2 speak about the impact that that 19,000 would have
3 specifically on the recharge rate of 13,000? I mean, I
4 guess I'm trying to figure out the detriment that you
5 are pointing out by bringing up that 19,000 number.

6 THE WITNESS: If there is not good hydraulic
7 conductivity between what you're injecting and what
8 you're producing, I think that water will stay in your
9 local aquifer. And if you are putting the geothermal
10 water at 150 percent the rate of your recharge, I think
11 it is going to start -- the whole valley will start to
12 look like the geothermal water.

13 COMMISSIONER PADILLA: So, essentially,
14 based on a lack of conductivity, you think that plume
15 that we saw on several maps would expand because of
16 these numbers?

17 THE WITNESS: Yes.

18 COMMISSIONER PADILLA: Okay. Moving to the
19 power plant and some of your calculations for damages, I
20 just want to be absolutely clear, there is no power
21 plant currently whatsoever?

22 THE WITNESS: True.

23 COMMISSIONER PADILLA: And when you did your
24 projections or calculations, for, you know, monetary
25 loss based on fall-off and based on water usage, did you

1 do a projection as to what kind of water use that plant
2 would require?

3 THE WITNESS: No. The plant will be
4 nonconsumptive in terms of water use. So I did not -- I
5 mean, if they go to wet condensers, they could use some
6 water. But as I understood it, that was not the plan.

7 COMMISSIONER PADILLA: Other than scale, how
8 would that be different from the Lightning Dock proposal
9 and its affect on the plume?

10 THE WITNESS: About an order of magnitude
11 different. I mean, that is just based on flow rates.

12 And the injection well that they have
13 eyeballed for it is actually -- I don't remember the
14 depth, but it's a deeper injection well. They are not
15 planning to inject in the alluvium.

16 COMMISSIONER PADILLA: Ballpark depth?

17 THE WITNESS: Say again.

18 COMMISSIONER PADILLA: Ballpark depth?

19 THE WITNESS: I would get in trouble if I
20 ballparked.

21 COMMISSIONER PADILLA: I am just trying to
22 get the clarification of one system having a negative
23 impact, but, then, you're talking about a proposed power
24 plant and --

25 THE WITNESS: Well, they are downstream of

1 the Cyrq power, you know, the production and injection
2 wells. And so anything they do is not going to go up
3 the gradient, the hydraulic gradient of the flow moving
4 through the valley.

5 So this is a case where what Cyrq does, you
6 know, has the potential to do them harm, but what they
7 do is not going to harm Cyrq.

8 COMMISSIONER PADILLA: I am not so much
9 concerned about Cyrq in this case, as, you know, the --
10 if we are talking about one power system, power
11 generation system, having the potential to harm wells
12 outside of its immediate vicinity, how is the secondary
13 one, albeit smaller, not going to do the same thing?

14 THE WITNESS: I hear your question now. I
15 mean, I think their plan to inject deeper and not in the
16 alluvial -- it is still a closed system. I mean it just
17 amazes me that anybody could use the term to describe a
18 geothermal system because you have so many flows going
19 in and out.

20 But the intent is to put it underneath the
21 alluvial aquifer that is there. That is what is
22 different as I understand it.

23 COMMISSIONER PADILLA: I think the rest of
24 the questions are probably better directed --

25 THE WITNESS: Sure.

1 COMMISSIONER PADILLA: -- so, thank you.

2 EXAMINATION BY COMMISSIONER CATANACH

3 COMMISSIONER CATANACH: I have just a couple
4 of questions. On your temperature degradation, I just
5 want to understand some of the factors that you've used
6 to calculate that or determine the 20-degree drop.

7 Was that based on the amount of fluid that
8 Lightning Dock is going to inject?

9 THE WITNESS: The 20 degrees was something
10 that I just started with as a starting number. And then
11 I said, Well, if they inject at 170, how much of that
12 170 would have to mix with my 232 to bring it down
13 20 degrees?

14 And that's 32 percent. So you would need
15 32 percent, 170, and the rest, 232, and when you mix
16 them, you get 212.

17 So there is not, you know, a detailed
18 computation -- I mean, I don't know how much they are
19 going to mix. But the potential for mixing, I think,
20 when you talk about the injection rate, is clearly
21 there.

22 COMMISSIONER CATANACH: If you were going to
23 look at the whole system and what they were going to
24 inject, could that 20 degrees be actually higher?

25 THE WITNESS: Yes. I mean, just -- I mean,

1 150 percent of the recharge rate -- I mean, if we get
2 50/50, it's going to be more than 20 degrees. It's
3 probably going to be more like 35, 40 degrees.

4 I mean, you could actually cool it down so
5 you are less than 200. And then, you know, the chance
6 of making power, it really gets difficult when you get
7 down in those low numbers.

8 I mean, it is not difficult to make the
9 power from a technology point of view. It is difficult
10 to make it pay for itself. It's just economically dead.

11 COMMISSIONER CATANACH: So your calculation
12 here is not based on the actual events that are going to
13 take place. This is just injecting 170-degree water
14 into the 232 -- that's basically what that is -- and
15 those two waters mixing.

16 THE WITNESS: Yes. I got the 170 degrees
17 from some of their injection logs, and then I backed out
18 what ratio that would be. And I do not know how much
19 mixing is going to occur.

20 COMMISSIONER CATANACH: Okay. Without going
21 too much into geology here, do you have an opinion as
22 to, within the proposed injection wells, they are going
23 to start injecting at 150 feet, which is in what you
24 described as the alluvium --

25 THE WITNESS: Uh-huh.

1 COMMISSIONER CATANACH: And I guess they are
2 going to have perforations down to 1,500 feet. Knowing
3 what we do about the permeability -- and the alluvium is
4 probably higher -- would that water tend to go into that
5 alluvium primarily before it goes into the other, deeper
6 zones in that injection well?

7 THE WITNESS: Yes. I mean, what is going to
8 happen is the well bore is going to fill up, and then
9 the water is going to try to get out. And, normally,
10 the water goes out the bottom of the bucket, but if
11 there aren't holes in the bottom of the bucket, which
12 would be permeability down there, not much of it's going
13 to get out. And if it is all up in the top, then that
14 water is just going to go out in the alluvium.

15 COMMISSIONER CATANACH: I have nothing
16 further.

17 COMMISSIONER PADILLA: Just one follow-up,
18 if I may.

19 EXAMINATION BY EXAMINER PADILLA

20 COMMISSIONER PADILLA: On what do you base
21 the assumption that there's no permeability at the
22 1,500-foot depth?

23 THE WITNESS: It's my understanding -- well,
24 it's not no permeability. It's low permeability.

25 COMMISSIONER PADILLA: Less permeability.

1 THE WITNESS: It is my understanding that
2 they first proposed they were going to drill deep,
3 inject deep. And they are trying that. And it's not
4 satisfactory because they come back and ask you to do
5 something different, rearrange their model.

6 I mean, I think, you know, the fact that
7 they are asking for a different injection site indicates
8 there's something wrong with that one. And there's only
9 two terms here that we need to worry about. One is how
10 hard you push on it, the pressure head; and the other is
11 the permeability, will it flow, the hydraulic
12 conductivity.

13 So just by reduction, without having access
14 to all the records, it's pretty obvious what the issue
15 is.

16 COMMISSIONER BALCH: May I do follow-up?

17 COMMISSIONER CATANACH: Yes.

18 EXAMINATION BY EXAMINER BALCH

19 COMMISSIONER BALCH: So I did go and look at
20 all their applications here, all of the perforated parts
21 of the well are at the projected depth of the alluvium
22 or below, right at in most cases.

23 THE WITNESS: Uh-huh.

24 COMMISSIONER BALCH: The injection method
25 is gravity, so the most head you're going to have is

1 150 feet at the level of where the perforations might
2 meet alluvium. Does that have an impact on how dramatic
3 the mixing rate would be?

4 THE WITNESS: It would. I mean, my whole
5 point here today is not to say I got a model. I don't.
6 But is to say what I've seen.

7 COMMISSIONER BALCH: What I am having a hard
8 time figuring out is if the formation in those four
9 wells from 150 or 500 feet down to 1,500 feet can't take
10 the water volume that they are trying to dispose of and
11 they are not pumping to push that water out, the only
12 thing you are going to have leaking to the alluvium
13 would be part of the head down to the top or probably
14 the base of the alluvium or where the top of your first
15 perforation is.

16 THE WITNESS: Uh-huh.

17 COMMISSIONER BALCH: So you're not going to
18 be having maybe as significant of a force pushing that
19 water out into the surrounding shallow aquifer,
20 certainly, as if you had a pump pushing it.

21 THE WITNESS: I think they are pumping on
22 their existing well like 60 p.s.i. or 70, somewhere in
23 that range. And I don't know why you would expect
24 between the bottom of the alluvium -- the stuff that is
25 the alluvium and, you know, what comes next, whatever it

1 is, I mean, why would they get away with a gravity head
2 there. I mean, they need to find fractures --

3 COMMISSIONER BALCH: That is what they are
4 proposing, is gravity heads for all four wells. So they
5 must have some reason to think that will work, because
6 if it doesn't work, they are going to have to drill more
7 wells or drill deeper or something. They're going to
8 have to find another way to get rid of their water.

9 THE WITNESS: Sure.

10 COMMISSIONER BALCH: They don't think
11 they're going to leak enough of it out into the
12 shallower aquifer that way, to take care of volume if
13 there's no conductivity down deep.

14 THE WITNESS: And I think immediately
15 beneath the alluvium, you probably are going to have a
16 lot of connectivity and -- I mean, there's certainly a
17 flow path there that would work with just gravity head.

18 And when you start pushing on it, then, you
19 know, it has the potential to make it worse. I would
20 just like to see a model about how this works.

21 COMMISSIONER BALCH: I agree with you 100
22 percent. Thank you.

23 MS. MARKS: I apologize but I was asking
24 Mr. Hand questions about the power plant, and he
25 directed me to Mr. Seawright, and then you fine experts

1 asked him a number of questions relating to questions
2 that I was going to ask him, and then that seemed to be
3 in direct contrast to certain documents in here.

4 So I think if we could clarify about certain
5 depths, it may be more appropriate if Mr. Hand answers
6 one question. I will certainly ask Mr. Seawright the
7 other question about other documents and applications,
8 but this one about depth, maybe Mr. Hand might be -- it
9 might be more appropriate because of the testimony he
10 gave you guys, in particular, Exhibit Q is
11 AmeriCulture's proposed depth at about 490 feet.

12 And Mr. Hand has noted to you folks that the
13 power plant would be -- AmeriCulture's power plant
14 injection would be deep and, according to the
15 application that Mr. Jackson also discussed, it would be
16 at this depth as well.

17 And I was wondering if Mr. Hand had actually
18 seen this application that Mr. Jackson also discussed,
19 that the proposed depth was actually 490 feet, which is
20 no different than the depths that Lightning Dock
21 proposes. I don't really see the difference. And so
22 that was -- with the whole power plant discussion and I
23 would have discussed that question with Mr. Hand, but I
24 thought Mr. Hand was directing me to Mr. Seawright. And
25 I know Mr. Padilla asked a question about the power

1 plant and questions about depths. Perhaps Mr. Hand
2 should answer that question.

3 THE WITNESS: I don't understand what the
4 question is.

5 MS. MARKS: Well --

6 COMMISSIONER PADILLA: If I might condense
7 it.

8 EXAMINATION BY EXAMINER PADILLA

9 COMMISSIONER PADILLA: I had asked what the
10 proposed project depths were, AmeriCulture's theoretical
11 power plant would be.

12 THE WITNESS: Sure.

13 COMMISSIONER PADILLA: And you said you
14 wouldn't be qualified to answer it because you didn't
15 remember, which is fair enough. But it's 490 feet.

16 THE WITNESS: Okay.

17 COMMISSIONER PADILLA: So having that piece
18 of information, can you now give us hopefully some
19 discussion as to the differential for harm, other than
20 scale, that each power plant would pose to the
21 surrounding water table?

22 THE WITNESS: I --

23 COMMISSIONER PADILLA: Basically why is
24 Lightning Dock something that you object to --

25 THE WITNESS: I would say that each of them

1 deserve scrutiny. I mean, I am not -- the reason I am
2 here today is to say, Look, what I have been presented,
3 based on the way I understand fluids and heat transfer,
4 the way this stuff works, that there ought to be a lot
5 of questions.

6 And so, you know, if that proposal is to
7 inject at 490 feet, there should be a defense of why
8 that's reasonable. I mean, I'm not in disagreement with
9 you.

10 COMMISSIONER PADILLA: I guess the issue I
11 would have with that answer is all of your damage
12 calculations are based on this power plant, which
13 includes a 490-foot injection depth. I just don't --

14 THE WITNESS: I don't understand what else I
15 would base damage calculations on.

16 COMMISSIONER PADILLA: I guess if you are
17 giving us damage calculations for a power plant, in my
18 mind, it is a power plant that you would theoretically
19 approve of or a plant that you would approve, an
20 operation that you would approve of --

21 THE WITNESS: I do agree with you that the
22 power plant is not built, and it's a future power plant.
23 But it's future harm that AmeriCulture could suffer if
24 the water temperature is throttled.

25 I mean, water rights are very specific

1 things, and all of the farmers and ranchers that I've
2 worked with, they zealously protect their rights.

3 COMMISSIONER PADILLA: So how does this
4 future harm of AmeriCulture and its power plant and the
5 power plant itself not impact those farmers and ranchers
6 whereas the Cyrq one would?

7 THE WITNESS: Again, he would have to be
8 injecting in some strata where he doesn't impact them.
9 I mean he should going through the same rigor that
10 everybody else has to go through.

11 I mean, I'm not -- look, I mean the main
12 thing I looked at was the stuff that I am most familiar
13 with, which is the turbo machinery, the power plant, you
14 know, the energy computations, and so on. I mean,
15 that's what I looked at.

16 If his temperature gets degradated, it is
17 going to have the potential to cause him harm. But that
18 doesn't mean that he gets to build this and harm his
19 neighbors.

20 COMMISSIONER PADILLA: I think I will just
21 leave it at that. Thank you.

22 THE WITNESS: Okay.

23 COMMISSIONER CATANACH: I don't know what
24 the status of AmeriCulture's application is, but I just
25 wanted to know, that application is 20 years old and I

1 don't know if that well was ever approved or what the
2 status of that well is or if he still intends to do
3 that.

4 And the other comment I had was on the
5 applications for injection, there's two boxes actually,
6 Injection to be gravity or pressure. And it is listed
7 as gravity.

8 And in the next box, it's, List approximate
9 pressure, and it says less than 100.

10 And I think there is some disparity there on
11 exactly what they propose to do in terms of the
12 injection pressure or gravity.

13 That's just a couple of comments.

14 THE WITNESS: I can't talk to the age of the
15 application or that stuff.

16 COMMISSIONER CATANACH: Okay. Is there
17 anything else of this witness? Mr. Lakins?

18 MR. LAKINS: Re-direct based on a few
19 questions.

20 COMMISSIONER CATANACH: Okay.

21 RE-DIRECT EXAMINATION

22 BY MR. LAKINS:

23 Q. Mr. Hand, just a few things.

24 Your calculation of potential harm to
25 AmeriCulture is based on a temperature drop in the

1 reservoir at AmeriCulture's well, correct?

2 A. It is based on temperature drop at the well head.

3 Q. And the proposed application on the table here
4 today that involves injection that's shallow from
5 withdraw of deep, right?

6 A. Right.

7 Q. And that's not what AmeriCulture's power plant
8 operation entailed. It was injection and production at
9 essentially the same depth; are you aware of that, do
10 you remember that?

11 A. Yes.

12 Q. And AmeriCulture's operation is totally in the --

13 MR. ROGERS: Objection. It is leading and
14 there is no foundation. The witness said he is not
15 familiar with the application and the question is
16 leading.

17 COMMISSIONER CATANACH: Can you restate it
18 or ask a different question?

19 MR. LAKINS: Certainly.

20 By Mr. Lakins (cont'd):

21 Q. I will withdraw that question.

22 A. I don't know about the plume.

23 MR. LAKINS: I thought Michelle Henrie was
24 the attorney, and Mr. Rogers' objection was out of
25 place, because he didn't ask a single question of this

1 witness. Now I am being double-teamed. I ask in the
2 future that that not happen.

3 MR. BRANCARD: Either one of their attorneys
4 can object as long as they both don't object.

5 MR. LAKINS: I would ask if we have an
6 attorney handling a witness, that that attorney handle
7 that witness; otherwise, I am being double-teamed, and I
8 don't think that's appropriate.

9 I pass the witness.

10 COMMISSIONER CATANACH: The witness may be
11 excused. And let's take a ten-minute break.

12 (Brief recess.)

13 Back on the record. You may call your next
14 witness.

15 MR. LAKINS: I call Jim Witcher.

16 JAMES WITCHER
17 having been first duly sworn, was examined and testified
18 as follows:

19 DIRECT EXAMINATION

20 BY MR. LAKINS:

21 Q. Mr. Witcher, please state your name.

22 A. My name is James Witcher.

23 Q. What do you do, Mr. Witcher?

24 A. I am a geologist. And most of my work is
25 associated with geothermal energy. And I do some ground

1 water exploration type work.

2 Q. Have you ever been qualified as an expert witness
3 before the Oil Conservation Commission before?

4 A. Yes, I have.

5 Q. Do you recall what you were qualified as an
6 expert witness as to testify to?

7 A. As I recall, I was qualified to testify on
8 geothermal, geology, geochemistry and geophysics.

9 Q. And could you give us a summary of your
10 qualifications in those four areas, please.

11 A. Well, my qualifications are I have been involved
12 with geothermal exploration and development for
13 37 years.

14 I have a bachelor's degree from New Mexico State
15 University and a master's degree from New Mexico State
16 University. And my master's thesis dealt with
17 structural geology, geochemistry and geophysics.

18 Q. And in your 37 years of experience dealing with
19 geothermal resources, et cetera, could you give us an
20 overview of what you have done?

21 A. Well, my first work in geothermal was at the
22 Arizona Geological Survey when it was at the University
23 of Arizona. And I compiled the first geothermal map of
24 the state of Arizona and was also co-author of the first
25 comprehensive report on the state of Arizona.

1 And since that time, I also have done work at New
2 Mexico State University at the Southwest Technology
3 Development Institute. And we were heavily involved
4 with direct use geothermal applications here in New
5 Mexico and other areas of the West.

6 In the process of that, New Mexico became the
7 largest operator of geothermal heat and greenhouses in
8 the nation. And since that time, I've left NMSU and I
9 do consulting work now.

10 And in process of that, I have done projects with
11 the National Labs, DOE, and I have worked with every
12 state in the western U.S., except Washington and
13 Montana, on mostly direct use sorts of applications, but
14 some have dealt with evaluation of geothermal leases for
15 high temperature power generation.

16 Q. Talk to me about your experience in geochemistry.

17 A. My thesis was geochemistry. One of the things
18 that I've done in the geochemical area is I've developed
19 a new geothermometer for low temperature resources when
20 I worked in Arizona. It's a carbon dioxide correction
21 to the silica geothermometers for low temperatures.

22 And I have also developed a technique to explore
23 for geothermal resources used in radon soil gas. And so
24 those are a couple of items that I have applied.

25 Q. How about geophysics?

1 A. Geophysics, I have done a variety of geophysics,
2 including gravity surveys, SP surveys, and dipole-dipole
3 resistivity survey techniques.

4 And the dipole-dipole resistivity, probably
5 participated in probably 20 line miles of that sort of
6 survey work and interpretation. The SP work, I have
7 done surveys in at least five areas in southern New
8 Mexico looking at the geothermal resources.

9 MR. LAKINS: I didn't bring Mr. Witcher's
10 resume. I can provide that to the Commission tomorrow.
11 I tender Mr. Witcher as an expert in geophysics,
12 geochemistry and geothermal resources, and geology.

13 COMMISSIONER CATANACH: Any objections?

14 MS. HENRIE: May I ask a question?

15 COMMISSIONER CATANACH: Yes.

16 VOIR DIRE EXAMINATION BY MS. HENRIE

17 MS. HENRIE: Mr. Witcher, the geothermometry
18 work, was that published?

19 THE WITNESS: It was published as a
20 technical report, and it wasn't published in a peer
21 review journal.

22 MS. HENRIE: Do you remember the name of the
23 report? That is one I haven't seen.

24 THE WITNESS: I would have to give a
25 reference to you tomorrow.

1 MS. HENRIE: Can you go more into your
2 qualifications for geochemistry?

3 THE WITNESS: I can talk about some course
4 work I've had. I've had course work in aqueous
5 geochemistry, isotope geochemistry. And I have also had
6 a course that was mainly chemical thermal dynamics,
7 which was an igneous petrology course.

8 MS. HENRIE: And that would have been at New
9 Mexico State?

10 THE WITNESS: Yes, that would have been at
11 New Mexico State.

12 MS. HENRIE: As part of your master's
13 program or --

14 THE WITNESS: Yes, that was part of my
15 master's program.

16 MS. HENRIE: Thank you. No objections.

17 COMMISSIONER CATANACH: Mr. Witcher, is most
18 of your testimony going to be with regards to geology?

19 THE WITNESS: It will be with regards to
20 geology, with some comments on using geochemistry and
21 some geophysics in the area.

22 And it will certainly be very geothermally
23 oriented. It won't be so much groundwater oriented.

24 COMMISSIONER BALCH: So the discussion we
25 are having up here, I am a geophysicist. In my studies,

1 of course, I have learned a little bit of geochemistry
2 and a little bit of geology. I would consider myself to
3 be primarily a geophysicist, an expert in a variety of
4 different fields in that area of study.

5 I'm not sure I would want to sit there and
6 be qualified as an expert in geophysics when I am really
7 trained as a geologist.

8 THE WITNESS: Well, I can tell you what my
9 course was in geophysics and maybe that will help you
10 see where I'm coming from. And with my other
11 experience -- I've had --

12 COMMISSIONER BALCH: This is more of a
13 broad question, and not specific to you. It's everybody
14 who is going to be a hydro geodynamic, chemistry
15 something or another -- you know, they're a geochemist
16 or a geologist.

17 THE WITNESS: Sure.

18 COMMISSIONER BALCH: That's your real
19 training. Why can't you just be a geologist?

20 THE WITNESS: I can be.

21 COMMISSIONER BALCH: I guess I don't
22 understand why qualify him in geophysics and
23 geochemistry and all that material -- and certainly he
24 is going to have some information that would be credible
25 in those areas, but he is really a geologist.

1 MR. LAKINS: The operating --

2 COMMISSIONER BALCH: If I have something to
3 do with a time lapse seismic survey using a 3D VSP
4 volume, and explain the processing to me, I don't know
5 if he could do that. That's a geophysical thing.

6 MR. LAKINS: Understood.

7 Some of the standard operating with
8 qualifications of experts that I have experienced before
9 the Division and the Commission has been rather broad.
10 And we have had this throughout this whole hearing as
11 well. I'll tender Mr. Witcher as an expert geologist
12 with extensive experience in geothermal, geochemistry,
13 and geophysics.

14 COMMISSIONER BALCH: That sounds a lot
15 better.

16 MR. LAKINS: Let's do that.

17 COMMISSIONER BALCH: And I am not trying to
18 diminish your qualifications in any way.

19 COMMISSIONER CATANACH: Okay. Mr. Witcher
20 is qualified as per Mr. Lakins' statement.

21 COMMISSIONER BALCH: I think we will make a
22 decision whether or not he's a geophysicist or a
23 geochemist.

24 BY MR. LAKINS (cont'd):

25 Q. All right. Mr. Witcher, could you explain to us

1 your experience with the Lightning Dock Geothermal
2 resource?

3 A. Well, this goes back a long ways. When I was an
4 undergraduate at New Mexico State University, one of my
5 professors had a project, a joint project with the
6 University of New Mexico.

7 And Dr. Chan Swanberg was tasked with collecting
8 water samples. And I was one of the students that
9 collected this data that's in circular 177. So that was
10 my first introduction to this.

11 And then as a part of that also, George Jurassic,
12 who was a professor at the University of New Mexico,
13 they were doing geophysical surveys, mainly electrical.
14 And so I participated a couple of afternoons out while
15 they were collecting resistivity data. And Chan
16 Swanberg also had a student collecting gravity data.

17 And so I was tasked every once in a while to go
18 out with the gravity bunch, and we would collect gravity
19 data.

20 Since that time, I did work every once in a while
21 for Dale Burgett. I had a temperature logger at NMSU,
22 and I would come over and take detailed temperature logs
23 of some of his wells.

24 And then later on, Damon Seawright started his
25 operation over there, and so I developed a close

1 relationship working with Damon and AmeriCulture.

2 And so that's culminated really in where I am at
3 with my experience with Lightning Dock Geothermal, is it
4 started as a student to where we are today.

5 Q. I take it you weren't a student just real
6 recently?

7 A. No.

8 Q. What year was that?

9 A. The year that we were out at Lightning Dock was
10 in the summer of 1975.

11 Q. So you have been doing studies in that area for
12 the better part of 40 years?

13 A. I wouldn't say professional studies, but,
14 certainly, I started looking at that area in 1975.

15 Q. You have been very familiar with it over the
16 time?

17 A. Yes.

18 Q. Have you published anything about the Lightning
19 Dock Geothermal area?

20 A. I have, but I can't recall it right now.

21 Q. Okay. Have you written any analyses about the
22 Lightning Dock Geothermal area that have not been
23 published?

24 A. There are probably analyses that haven't been
25 published. And I couldn't give you an outline on that

1 right now.

2 Q. In preparation for this hearing, just for this
3 hearing, could you tell us what you did in preparation
4 for your testimony here today?

5 A. Well, one of the first things I did is I reviewed
6 Circular 177 as this was presented in evidence by
7 Lightning Dock. And I also went back and read the old
8 report that I had done on the pump test.

9 And I looked at various other published articles
10 in the literature on the Lightning Dock area. There is
11 probably too many that I can't recall really right now
12 to say what they were, but I looked at them.

13 Q. You were here for the prior testimony?

14 A. Yes.

15 Q. And you were here for the -- you testified and
16 were at the hearing in 2013?

17 A. Yes.

18 Q. Did you have a chance to look over any of the
19 transcripts of the testimony from the hearing last
20 month?

21 A. I read portions of that. I didn't read it from
22 cover to cover, but I read portions of that testimony,
23 yes.

24 Q. And do you recall what portions those were?

25 A. In particular I looked at the testimony, some of

1 the testimony that Dr. Greg Miller had presented and
2 Dr. John Shomaker had presented, and also some of the
3 information that was presented by Mr. Roger Bowers.

4 Q. Have you formed an opinion about these four
5 proposed injection wells?

6 A. I am worried that what they are proposing to do
7 is they are going to inject a lot of geothermal fluids
8 into a shallow aquifer and they are going to create
9 additional outflow plumes or add to the existing outflow
10 plume, and that the amount of water that has been
11 suggested to go back into the primary reservoir is not
12 going to occur because it's not permeable enough to
13 transfer that water back into the geothermal reservoir,
14 rather it would get short-cutted by the high
15 permeability sediments up closer to the surface.

16 Q. Do you have any other opinions or concerns?

17 A. Well, one of the other opinions that I do have is
18 I believe that the geologic model that was presented,
19 which is a continuance of the model in 177, I believe
20 the model is completely wrong.

21 Q. And why is that?

22 A. Well, I don't believe the temperatures that they
23 say in the primary reservoir to the southwest exist. I
24 also do not believe that there is a magnetic heat source
25 out there. And I'm prepared to go through all of that.

1 I don't believe that the reservoir size is nearly
2 as large as what is claimed to be. And I believe that
3 there's really been no information presented to anybody
4 in terms of cross-sections and the structural geology
5 there by Cirq.

6 But I've managed to pull together some of that,
7 and we will talk about that. And I'll use that to make
8 an argument that that resource is very, very small.

9 And I also did a calculation, which is a
10 volumetric calculation that industry has used, the U.S.
11 Geological Survey uses it in their evaluation of
12 resources. A company, Geothermics, uses it. It's a
13 volumetric method, is what it's called.

14 And I applied it with the numbers I came up with
15 at Lightning Dock. And it shows that production of ten
16 megawatts of electrical power is not sustainable.

17 Q. You put together a PowerPoint presentation?

18 A. Yes, I did. This is just really --

19 MR. ROGERS: And I believe this was the one
20 that we objected to because of the new documents that
21 were not provided pursuant to the schedule. So before
22 he goes through that, I'd request that we hear objection
23 upon that and have a ruling, before he talks about
24 evidence in his exhibits that I do not believe should be
25 in the record.

1 MR. LAKINS: I think there is a difference
2 between exhibits being put into the record for evidence
3 and Mr. Witcher's own testimony from visual aids and
4 PowerPoint presentations.

5 And it would seem -- so I haven't moved this
6 for admission yet nor have I moved the prior one for
7 admission. And in fairness we had lengthy PowerPoint
8 presentations before that we should allow Mr. Witcher
9 the opportunity to give his testimony and then deal with
10 an inadmissibility objection, rather than having to pick
11 out and not permit him to talk to the substance of his
12 opinions.

13 MR. ROGERS: May I?

14 COMMISSIONER CATANACH: Yes.

15 MR. ROGERS: The objection is that the
16 exhibits should not be addressed or shown until it is
17 properly admitted. You don't go through the exhibit,
18 give you all the information, and then move the exhibit
19 there, because the prejudice is done.

20 Our concern is that this contains -- 16 of
21 the 19 pages are new. 16 of the 19 pages are new things
22 that could have been done timely, could have been
23 supplied at the time and were not.

24 And the difference between an exhibit and an
25 demonstrative exhibit is not we get to ambush you with a

1 demonstrative exhibit. It is a demonstrative exhibit
2 has to depict and illustrate the existing testimony.
3 You can't come in -- you shouldn't come at an
4 adjourned session here with a whole new set of these
5 matters.

6 We have objected from the very beginning
7 about the failure to provide the proper objections.
8 This is a piece and akin to that same matter.
9 It should not be allowed. It should not be allowed up
10 there for you to review before it is admitted and it
11 should not be admitted.

12 MR. LAKINS: In all fairness, the prior
13 hearing, we were ambushed with PowerPoint presentations
14 aplenty. We also have had information withheld that we
15 requested in HIPPA requests and even motions before this
16 council, that there's a ton of missing data that Cyrq
17 has that isn't on the table and hasn't been provided
18 despite request.

19 This presentation of Mr. Witcher's is no
20 different than what we saw before where we were not
21 provided any sort of information from Cyrq's witnesses
22 or exhibits beforehand, and they gave PowerPoint
23 presentations, and that was supporting their testimony.
24 That was allowed. This is no different.

25 MS. MARKS: Just so the record is clear, OCD

1 did not receive this exhibit until the start of the
2 hearing or when the hearing had already commenced. We
3 didn't get a chance to review this, discuss this with
4 any internal personnel within the OCD.

5 And we view it as prejudicial to the OCD.
6 All exhibits were submitted with the prehearing
7 statements and changing the exhibits now we do feel is
8 prejudicial.

9 MR. BRANCARD: I think this is very
10 important, but I think the Commission has, in general,
11 been fairly liberal at letting parties provide
12 PowerPoint presentations to sort of let them walk
13 through their testimony.

14 I think there is some fairly detailed
15 documents in here that kind of go beyond the normal
16 discussion overview type slide here that the Commission
17 may want to discuss whether to admit as exhibits or
18 not.

19 But I would disagree with Mr. Rogers here.
20 The Commission's practice has been to have people walk
21 through exhibits and then decide later whether to admit
22 them. That is sort of the way it's done.
23 Obviously, if it is not admitted as an exhibit it can't
24 be used as part of the record and part of the evidence
25 in support.

1 So I guess I would say that you allow the
2 witness to walk through it and then decide whether you
3 want all or part of this to be admitted as an exhibit or
4 if you think it is in any way prejudicial to the
5 parties.

6 I think there's a lot of detail in some of
7 the stuff here that you may not want to have unless the
8 parties are given much more time to respond to and to
9 extend this hearing to respond to these.

10 MR. ROGERS: May I respond?

11 COMMISSIONER CATANACH: (Nodding head in the
12 affirmative.)

13 MR. ROGERS: The specifics here, this is not
14 illustrating existing testimony or for something. This
15 is new, particularly technical sort of material that
16 should have been promptly provided at the time.

17 And I understand at some level the history
18 and the practice of the Commission. But let me point
19 out to you the prejudice of that. If this exhibit is
20 not properly before you, I would recommend that you
21 consider that before the time is spent going through the
22 matter. I would recommend that you consider the
23 prejudice of this new, very technical information, and
24 ask yourself the question as to why this couldn't have
25 been provided timely.

1 And I would suggest there is only one answer
2 to that, and that is to avoid effective
3 cross-examination and avoid the opportunity to
4 effectively address this witness's new points presented
5 here.

6 And so recognizing the OCC has procedures
7 and, perhaps, a history, I recommend to you now it's
8 time to reconsider that history, because he has 16 new
9 technical slides here that are not illustrating existing
10 testimony. They are new.

11 And so for those reasons, I'd recommend that
12 you not accept exhibits or not go through exhibits and
13 then consider admission, but, rather, that they be
14 established as reliable and appropriate before you spend
15 that time going through them.

16 Thank you for indulging me.

17 COMMISSIONER CATANACH: We are going to just
18 take a couple of minutes to discuss this.

19 MS. MARKS: Mr. Chairman, I think if the
20 original exhibit differs significantly that perhaps
21 those differences could be explained by the expert as
22 well, between the two exhibits. Maybe the theory has
23 changed. I don't know why the exhibits changed so much
24 between the initially filed exhibit and this.

25 COMMISSIONER CATANACH: I move that we go

1 into executive session.

2 COMMISSIONER PADILLA: I second that motion.

3 COMMISSIONER CATANACH: All in favor say

4 "aye."

5 COMMISSIONER BALCH: Aye.

6 COMMISSIONER PADILLA: Aye.

7 (Brief recess.)

8 COMMISSIONER CATANACH: We are back on the
9 record. And at this time, we will turn it over to
10 Mr. Brancard.

11 MR. BRANCARD: We need a motion to go back
12 into open session.

13 COMMISSIONER CATANACH: I'm sorry. Can I
14 have a motion to go back into open session?

15 COMMISSIONER PADILLA: So moved.

16 COMMISSIONER BALCH: I'll add to the motion,
17 the one thing we discussed was the issue of Exhibit V.
18 And now we're set.

19 COMMISSIONER CATANACH: All in favor.

20 COMMISSIONER PADILLA: Aye.

21 COMMISSIONER BALCH: Aye.

22 MR. BRANCARD: The Commission considered,
23 went through the original proposed Exhibit V that came
24 in the prehearing statement and the new Exhibit V that
25 has been proposed today by AmeriCulture. It has been

1 determined that the differences between the two exhibits
2 are fairly significant and that many of those
3 differences relate to highly technical drawings and
4 matters presented in the new Exhibit V. Therefore, the
5 Commission determines that it will only accept the
6 original Exhibit V at this time as an exhibit due to the
7 prejudice to the parties.

8 So if you want to go ahead with the original
9 Exhibit V -- I don't know if you have that on your
10 computer. We all have it in front of us.

11 MR. LAKINS: Here is what I would like to
12 do, because we are talking about an exhibit but we are
13 also talking about testimony, and a large part of what
14 those new exhibits are are essentially directly
15 addressing evidence that was presented by Cyrq at the
16 prior hearing, including the Piper diagram.

17 What I would like to have the opportunity to
18 do is to give Mr. Witcher a hard copy of the new so that
19 he can talk about the slides that are in the new and use
20 them and at least give him the opportunity to discuss
21 those, because they are realistic comparisons of data
22 that was provided and presented previously. And that's
23 what the majority of those new slides are.

24 And I am trying to get on the Internet right
25 now so I can provide that to Ms. Marks. And that is

1 what I request to be able to do, is let him at least
2 discuss his slides, because that's his testimony and
3 that's presentation, but those slides would not be
4 admitted into evidence, but he should be given the
5 opportunity at least to talk to them.

6 MR. BRANCARD: Mr. Rogers.

7 MR. ROGERS: Commissioners, Mr. Brancard, I
8 think we will have to handle it on a bit by bit
9 analysis, because whether the new material is on a slide
10 or whether it's new proposed oral testimony, if it
11 wasn't reasonably noticed, the prejudice is the same.
12 But I am afraid we are going to have to do it almost
13 topic by topic.

14 And so I do object to the cheat sheet beside
15 him with all of the information that was just ruled as
16 impermissible. I do object to that.

17 MR. LAKINS: I think there is a difference
18 between impermissible slides and his ability to testify.
19 He hasn't been given to a chance to testify at all yet.

20 And his ability to testify, particularly in
21 comparing the testimony and rebutting the testimony that
22 was given previously, is part of his analysis of that
23 and his comparison of that. It isn't even on the table
24 yet. And the slides that he has are comparative visuals
25 of what was given and what his testimony will be. That

1 should not be prevented. He should be allowed to give
2 his testimony.

3 MR. BRANCARD: Yes, yes. Mr. Witcher should
4 go ahead with his testimony. I believe some of
5 Lightning Dock's witnesses had pieces of paper they
6 relied on while they testified also, so...

7 MR. LAKINS: What I need to be able to do
8 then is to get a copy of the exhibit --

9 COMMISSIONER BALCH: Have one of ours.

10 MR. BRANCARD: We are not using them.

11 MR. LAKINS: Thank you. This is the prior.
12 I think we can take note that this document that I have
13 projected up here is 16 pages, which is the original
14 Exhibit V. And what I also will be using will be pages
15 from the new as well for Mr. Witcher to be able to speak
16 from.

17 I think that's the directions that I have
18 been given. If I've misunderstood, please tell me.

19 MR. BRANCARD: The Commission should just be
20 seeing the original. You can look at them on your
21 screen and he can look at them, but the Commission
22 should just see the original Exhibit V.

23 MR. LAKINS: So the Commission -- I can't
24 show the Commission slides, as part of his testimony,
25 that aren't in this presentation, even though we had

1 that same exact scenario last time where there were a
2 number of slides shown that had not been presented and
3 given to us ahead of time.

4 What I am hearing is I am restricted from my
5 witness being able to give his presentation thoroughly
6 using any sort of visuals when that exact thing happened
7 prior? I just want to make sure I understand that.

8 MR. BRANCARD: Mr. Rogers.

9 MR. ROGERS: Yes, that was the ruling. The
10 new exhibits are technical, they are complex. They are
11 supplied to us for the first time today and there is no
12 explanation, no reason and no justifiable purpose in
13 allowing that sort of ambush.

14 And, yes, so, for instance, the new exhibits
15 which you have up there are improper and they should not
16 be up there. That was the ruling.

17 And if I understood, I said that certainly
18 some latitude is allowed on his examination. I
19 understand that. I understand that is the nature.

20 It may get into something that is unfair, that --
21 but I think we address it question by question. There's
22 no blanket now that he can read from the exhibit that's
23 ruled out, because it's recognized that that was
24 prejudicial.

25 And so it is not a perfect line here. It's

1 a bit of a fault in conductivity here, but the issue is
2 should he be allowed to testify to something that should
3 have and could have been provided timely to allow our
4 experts the opportunity to look at it, instead of
5 hitting them on the fly.

6 So my understanding of the proper way to
7 proceed is to proceed, to ask him the questions, and to
8 the extent that we believe they are unfair or out of
9 bounds or something that should have been done, we'll
10 object. But to allow him to put it up there and to
11 allow him to read from the exhibit that was determined
12 to be prejudicial wouldn't be correct.

13 COMMISSIONER BALCH: That is more or less
14 the way we interpreted it. I mean, you can ask him any
15 questions you want.

16 MR. LAKINS: One of my slides is their
17 exhibit.

18 MR. ROGERS: And we accept that one.

19 MR. LAKINS: It is in evidence, that they
20 presented.

21 MR. ROGERS: No objection.

22 MR. LAKINS: And next to it is Mr. Witcher's
23 comparison; it's a Piper diagram, which is
24 straightforward data. And it's a side-by-side
25 comparison of the applicant's exhibit that Mr. Miller

1 spoke from --

2 COMMISSIONER BALCH: I think when you ask
3 Mr. Witcher a question about that slide, then you would
4 then ask to introduce that data if you could. We would
5 address that presumed objection at that time.

6 MR. LAKINS: Very good.

7 DIRECT EXAMINATION BY MR. LAKINS (cont'd):

8 Q. Mr. Witcher, you had put together two different
9 PowerPoint presentations in preparation for today. I'm
10 going to talk to the first one, the one that has been
11 presented initially. Are you with me?

12 A. I am with you.

13 Q. And then you hear what we got to do, so we are
14 going to go through this first.

15 A. We'll figure it out.

16 Q. All right. Now, Mr. Witcher, if you would,
17 please, give us an overview of what your testimony is
18 going to be and what this PowerPoint presentation
19 includes.

20 A. Okay. I think the first thing that I'm going to
21 say is we are going to talk about the geothermal matter
22 that's being used at Lightning Dock. And this model
23 comes out of Circular 177, which is the paper that is
24 published by the New Mexico Bureau of Geology. The
25 author is Elston, Beale, and Logsdon.

1 And near the end of their report, they have a
2 large figure. It is a page-sized figure. It shows
3 their model that they developed.

4 And in this model they show a basaltic magma in
5 the subsurface. It is heating fluids to 250 degrees
6 centigrade.

7 And then this water is boiling and it is creating
8 a steam cap that then condenses. And then this
9 condensed water then flows laterally to the northeast to
10 Lightning Dock, where it upwells as a 150-degree C
11 resource.

12 And this is the framework that was provided by
13 Mr. Roger Bowers and Dr. Miller. And what I would like
14 to do is --

15 COMMISSIONER BALCH: This figure in
16 Exhibit 6 of Lightning Dock?

17 THE WITNESS: Yes.

18 COMMISSIONER BALCH: Page 40, Exhibit 6.

19 Q. Please continue.

20 A. Okay. And what I am going to show and discuss
21 and argue is that there is no magma chamber in the
22 Animas Valley. And if there was a magma chamber in the
23 Animas Valley, it would be clearly evident that it's
24 there.

25 There is a magma chamber in New Mexico in the

1 subsurface at roughly 18 kilometers depth beneath
2 Socorro and Belen. And this magma chamber has
3 micro-earthquake forms on a regular basis. It is a
4 highly active area.

5 And you can go to another area in New Mexico that
6 has magma in the subsurface. It is a small amount. It
7 has been identified seismically. And this particular
8 area, it's also seismically very active. And it also
9 has very young rhyolitic extrusions to the surface.

10 Battleship Rock and San Diego Canyon in the Jemez
11 Mountains is, in particular, what I am speaking of. And
12 that is the only high temperature resource that's been
13 identified in New Mexico. And it has a high temperature
14 resource.

15 At Lightning Dock, there's no rhyolite bodies
16 near the surface. There's no micro-seismicity. And
17 there's no indication of fumeroles or anything like
18 this. And this is the sort of thing you'd see with a
19 magma-generated body or geothermal resource.

20 The other thing that is told there is that a
21 basaltic magma can be a heat source for a hydrothermal
22 geothermal system, and that is not possible, only if you
23 are in an area like Iceland or if you are in an area
24 like Hawaii, where you have tremendous volumes of basalt
25 being erupted into the shallow crust.

1 What happens with these small basalt volcanic
2 fields that we have in the Southwest, you have cinder
3 cones and lava flows that are fed by dikes. And these
4 dikes are probably less than 100 across or thick. The
5 volume of magma that is extruded into the shallow crust
6 has a huge surface area compared to the volume.

7 And there is a classic book that was printed in 1959
8 by a couple of mathematicians, Carslaw and Jaeger. And
9 they developed several really interesting little
10 mathematical solutions for that problem.

11 And you can go through that and calculate that
12 100-feet-thick, 30-meter-thick magma body will cool to
13 ambient temperature in a matter of years or tens of
14 years. And that's not going to support a hydrothermal
15 system that's circulating water past it.

16 So we can throw out the magma model for Lightning
17 Dock creating a 250 degrees C resource out to the west.

18 And this is important to understand, because one
19 of the arguments that Cyrq and Lightning Dock is trying
20 to make is if the resource they are tapping into near
21 where their power plant is is it's huge and vastly
22 expansive and extends back to the southwest.

23 And they plainly stated that they were using the
24 model of Circular 177. And so the magma argument, I
25 would say, that that doesn't apply. There's no evidence

1 for a magmatic heat source out there, even a magma body,
2 because if it was there, we would see a lot of evidence
3 for it. These things, they don't hide themselves very
4 easily.

5 The other issue that comes up is the 250-degree C
6 resource. And in 177, Logsdon, the person that did the
7 geochemistry on this used an empathy silica diagram.
8 And he misapplied that silica empathy diagram. A silica
9 empathy diagram was developed by Fournier and Truesdale.
10 They're the fathers of a lot of geochemistry.

11 And they put several stipulations on the use.
12 And one of the stipulations is is that after mixing
13 takes place, there can't be any loss of silica. And any
14 temperature change that occurs with mixing has to result
15 just from mixing; you can't have conductive heat loss
16 off that flow of water.

17 And I don't think that those sorts of things
18 apply at Lightning Dock because they are using wells to
19 do this evaluation.

20 The original intent of that technique was
21 developed for large flow thermal springs in volcanic
22 areas, in particular, Long Valley Caldera in California
23 in Yellowstone. And this is what they developed it for.

24 The other thing that the diagram fails to --
25 fails is when you have boiling in the subsurface. And

1 if you have boiling in the subsurface, that causes the
2 silica content to increase, because water leaves and is
3 steam and you increase the concentration of silica. It
4 is like increasing the concentration of a salt. And so
5 that causes it to deviate.

6 However, you can make a correction to that if it
7 is just a one-stage boiling. You did use the steam
8 curve, use that to correct -- to get a proper
9 temperature.

10 And I went through that process. And the
11 temperature that you come up with is 165 degrees C,
12 which is exactly in the framework of what the resource
13 that's currently being tapped, which is in the order of
14 155 or a little more degrees Centigrade.

15 Q. Okay. Jim, let me bring you back to the slide,
16 to the summary of what you are going to talk about --

17 A. Okay.

18 Q. Don't get into all the detail yet. All right.

19 Give me a summary of the known subsurface
20 geology. And I am going to refer you to your --

21 A. That's not the slide we want to use for that.

22 Q. This one?

23 A. The one just prior to that. This is a -- it's
24 not a cartoon, but it's almost. But what I wanted to
25 show here was the main structural elements that you see

1 in the vicinity of the Lightning Dock Geothermal system.

2 And the circular 177, they did an extensive
3 mapping campaign in the Pyramid Mountains to the west,
4 and they identified a silicic caldera of the Oligocene
5 Age. And that's what's called Muir Caldron there.
6 These caldrons or caldera, basically -- it has a ring
7 fracture around the outside of the crater that fills in.

8 And what I show in a dashed line there is my
9 estimation of where that outer ring fracture zone is
10 coming through there. And that is based upon core
11 information out of that well number -- that yellow dot
12 that you see, number two there.

13 The other important feature that we see there
14 that goes back to fracture permeability or to reopening
15 of older fractures, and that's the Pleistocene Animas
16 Valley Fault.

17 And I ended about where you see, Hot Wells Horst.
18 I mapped that fault. That fault does not continue to
19 the south. But it ends right there.

20 And that's a good place for good fractures to
21 form, is on the horsetails or the end of these faults.
22 So that works.

23 These gray bars that you see with another little
24 bar with a ball on the end of it, I call those
25 geophysical faults. And they are identified by using

1 gravity data.

2 It's not a calculation or anything like that. It
3 is basically eyeballing the map and seeing where the
4 gravity gradients increase. So those areas, you are
5 looking at where the gravity contours are very close
6 together from a gravity survey.

7 Gravity survey's map, mass are density
8 differences in the subsurface. So where you have a
9 large contrast between higher density and lower density
10 materials, you'll get a steep gradient. And a lot of
11 times that ends up being a fault zone. So that is what
12 those gray areas represent.

13 And what you outline there is a gravity high that
14 is shown by the Hot Wells Horst. It is separated by
15 steep gravity gradients, which are the faults.

16 And then you have out to the west and east areas
17 of lower gravity. And that is what I called the Lower
18 Animas Graben. And there is another little graben
19 between the Pyramid Mountains and the Hot Wells Horst.

20 It's important to note the Pleistocene Valley
21 Fault is not a large fault. It's just a young fault.
22 It is what I would call an incipient fault.

23 It has no gravity signature. In fact, it cuts
24 across the Hot Wells Horst high there or Horst Block,
25 which is an uplift in geological terms, bound by normal

1 faults.

2 Then there is an older feature, which I call a
3 west, northwest landlocked tectonic inversion. And that
4 is geo jargon for a feature that first formed during the
5 Jurassic, is a large normal fault.

6 And then -- and where the hanging wall side of
7 that fault dropped downward and forged a basin, a rift
8 basin, kind of like the Albuquerque Basin. And then the
9 upthrown side which would have been to the north, formed
10 a Horst block.

11 And then this was eroded. And then you had a --
12 you changed the regional stress field and everything
13 reoriented itself. And that normal fault then became a
14 reverse fault. And the motion on that fault reversed
15 itself.

16 And the reason that's important is these zones
17 with repeated deformation over time created a lot of
18 fractures. And so all these things kind of coincide
19 with one another to create fracture permeability.

20 Now, what I should point out is that west,
21 northwest Laramide tectonic inversion zone that I show
22 there, that's -- I am basing that on core hole -- or
23 well data between Well No. 1 to the north and Well No. 2
24 and Well No. 3.

25 These are very deep holes, that the 1 and 3

1 wells, they went into basements. So I could see the
2 full picture there.

3 And I have a published paper on that. And it
4 goes into the detail. We don't need to do that.

5 I just wanted to show that there's repetitive
6 deformation with west, northwest deformation on it. We
7 see that in southeast Arizona and southwest New Mexico.
8 And they are the first order of structures in the whole
9 region. And they go back to the Precambrian.

10 And that latter phase of faulting, the reverse
11 faulting that took place there, it had associated thrust
12 faults with it that are sometimes mistaken as the
13 overthrust belt. There is no such thing as an
14 overthrust belt in southeastern Arizona and southwest
15 New Mexico.

16 But what you may have is some structures like
17 that that are embedded in the bedrock beneath the
18 territory volcanics and Hot Wells Horst. And I made
19 cross sections, and I am not even going to attempt to
20 show that, because the only way you would be able to see
21 that would be with some very good seismic reflection
22 data, even if they could see that.

23 Q. Does that kind of wrap up your summary?

24 A. That wraps it up.

25 Q. The next topic that you are going to talk about

1 is the isotopic composition?

2 A. Yes. The isotopic composition that I was
3 originally going to talk about, I've added some other
4 things, because in the testimony before, Greg Miller
5 introduced an analysis of oxygen, 018 to 016, ratio.
6 It's not a percent ratio. It's a permil ratio based
7 upon a standard mean ocean water that they use as a
8 standard.

9 And what he argued was that this minus 13 value
10 that they had was evidence that there was boiling from a
11 250-degree C resource and then it was condensing and
12 flowing back over from the southwest to the northeast.

13 And what I was going to show here is I was going
14 to show a plot of oxygen isotopes versus hydrogen
15 isotopes. And when you do that, almost all data in a
16 continental setting plots up on a linear line, which we
17 call a mean water line. And it represents meteoric
18 water.

19 And on that meteoric water line, everything that
20 we see out in Lightning Dock plots within one mil of
21 that line. But it also tends to show how the mixing
22 takes place.

23 Oxygen and deuterium isotope information is one
24 of the most valuable geochemical tools you can use in
25 geothermal evaluation, and also in reservoir studies

1 after you are in development, because one of the things
2 you can see is see mixing.

3 And the other thing you see is if there is a lot
4 water/rock interaction, the oxygen isotopes will shift
5 permil off the mean water line to the right by five to
6 ten mil. And we don't see that at Lightning Dock.

7 And if there'd been a 250-degree sea resource,
8 that data that was reported by Cyrq in the last session
9 that we had here would have shown a shift to the right,
10 a significant shift to the right.

11 This data does not shift to the right. It is on
12 the mean water line. It is meteoric water.

13 Q. Is this one of the slides that you prepared?

14 A. Yes, it is one of the slides that I prepared for
15 this particular presentation.

16 Q. And is the testimony that you just gave
17 summarized in that chart --

18 A. I --

19 Q. -- for lack of a better term?

20 A. I'm not finished with that.

21 Q. Keep going.

22 A. Okay. One of the things it does show is it shows
23 mixing. And we can see from the mixing that there is
24 mixing going on between the fresh water and the outflow
25 plume water, which was measured -- that we have isotope

1 information for.

2 The only deep upflow zone water that we have
3 information for is the stuff that Cyrq presented last
4 time in minus 13. Everything else plots up into the
5 minus ten to minus eight region in terms of the oxygen
6 isotopes.

7 What we do see there, after mixing has taken
8 place, we see one-stage boiling. And I took a chart
9 that shows the depth head of water over a particular
10 depth and at what depth water would boil at a particular
11 temperature given a particular salinity.

12 And what pops out here, when you look at that
13 chart, is that if you had 250 degrees C water, it would
14 boil at a depth of about 150 feet, which would be a
15 little less or a little over 450 meters.

16 If you subtract the mean annual air temperature
17 from 250 degrees and divide that by that boiling depth,
18 you come up with a temperature gradient, a minimum
19 temperature gradient that -- what you see in that area.

20 And if you do a simple heat flow calculation, you
21 get a heat flow anomaly that would form over something
22 like that that is larger than what we see at Lightning
23 Dock today.

24 So that is more evidence that that higher
25 temperature stuff out to the southwest does not exist.

1 And so this business of using that for correlative
2 rights purposes or to show that they've got this huge
3 resource, that just does not apply.

4 To go back to the mixing, if you look at the
5 isotope, hydrogen and oxygen isotopes and do the mixing,
6 it's probably less than 20 percent mixing. It's not the
7 24 percent that's being thrown out. So it is a lot
8 less.

9 Q. Is that testimony that you just gave summarized
10 in a visual that you prepared?

11 A. Yes, it is.

12 Q. Can you tell me what page in that new --

13 A. That would be page five in the new PowerPoint.

14 Q. Is that --

15 A. That would be the water isotopes, water stable
16 isotopes.

17 Q. Is this what you are talking about?

18 A. That is exactly what I'm talking about.

19 Q. All right. Give me an overview, real quickly,
20 kind of summarize what your charts are showing in the
21 context of the testimony that you just gave,
22 Mr. Witcher.

23 MR. ROGERS: May I be heard?

24 COMMISSIONER CATANACH: Do you have an
25 objection?

1 MR. ROGERS: I do.

2 COMMISSIONER CATANACH: Go ahead.

3 MR. ROGERS: I object on the basis that
4 Mr. Witcher's underlying basis for his opinion is not
5 being produced with this. It is, again, technical,
6 complex, and undisclosed.

7 So what you have here, what you have here is
8 a diagram using a collection of materials not before the
9 Commission, not available to Lightning Dock to address,
10 but, again, an unfair presentation because of that.

11 And I don't object to testimony reflecting
12 Dr. Miller's testimony. That is fine. These
13 calculations here go much, much further than that and
14 they are prejudicial.

15 Q. (By Mr. Lakins:) Did that data come from
16 Applicant's Exhibit 9?

17 A. The two analyses on Well 55-7 came from that
18 particular exhibit.

19 Q. So a large part of the data that's in the slide
20 is --

21 A. Just two data points.

22 Q. Two data points. And the other data points you
23 said were from?

24 A. The other data points that are in are data that
25 was plotted up from data that was presented in Circular

1 177, which was their exhibit that they presented at the
2 last meeting. I just plotted it up.

3 Q. And that's Exhibit 6, Circular 177?

4 A. That's it.

5 Q. So all of the information that you derived for
6 this slide came from the exhibits in evidence already?

7 A. That's correct.

8 COMMISSIONER CATANACH: I'll allow it.

9 MR. LAKINS: I move to admit this slide,
10 Water Soluble Isotopes --

11 THE WITNESS: That would only apply to the
12 box on the left.

13 Q. What about the two boxes on the right?

14 A. I just drew those down from the literature to
15 illustrate what I was arguing.

16 Q. The scientific literature?

17 A. Yes.

18 MR. ROGERS: And my objection is that it
19 could have been done prior and it should have been done
20 prior.

21 And if I may, if I could clarify the record
22 here. So there is absolutely nothing else that you used
23 in coming to these conclusions other than 177 and these
24 two exhibits; is that correct?

25 THE WITNESS: And my expertise in this

1 particular field.

2 MR. ROGERS: And no other reference,
3 anything else --

4 THE WITNESS: I'm not sure --

5 MR. ROGERS: No other document that is not
6 listed?

7 THE WITNESS: No.

8 MR. ROGERS: Okay. I'm going to object to
9 the one on the left. The ones on the right could have
10 been and should have been produced timely.

11 And I have another concern, too.

12 Mr. Witcher is listed for 45 minutes. I
13 certainly understand that some of my objections have
14 slowed this down and stretched this out, but he has 16
15 new exhibits. If you give them about three minutes
16 each, my math -- and it is a lawyer's math -- comes out
17 to about 48 minutes.

18 And his summary was more than twenty
19 minutes. And so my concern about this is the length of
20 this and giving counsel fair notice of some end point in
21 this matter.

22 We are concerned that a significant portion
23 of this is not relevant and it is not for the purpose of
24 addressing application, but, rather, for some other
25 purpose. So my other objection has to do with the time

1 that this is going to take with 16 new exhibits, to go
2 through this.

3 COMMISSIONER CATANACH: Do you have an
4 estimate on the time it's going to take?

5 MR. LAKINS: It would have gone a lot faster
6 using this, because I am going to have to go through and
7 do this pretty much on several exhibits.

8 I think in all fairness, all the times --
9 and this goes for every witness -- were way under. We
10 spent two days for AmeriCulture's four hours of
11 anticipated testimony.

12 I intend to get through Mr. Witcher and
13 Mr. Seawright by the end of the day tomorrow, including
14 cross and questions from the Commission.

15 I hear Mr. Rogers' point, and I'm going to
16 do my absolute best to make it as snappy as possible,
17 sir.

18 MR. ROGERS: Thank you.

19 MR. LAKINS: I think that the testimony
20 that's here right now that is relevant goes to the
21 fundamental question here of the chemistry of the water,
22 the deep geothermal water and the difference in that
23 deep geothermal water and the water in the shallow
24 alluvial. That's, in essence, what this document and
25 Mr. Witcher's testimony on this point is really

1 fundamentally about. It's important for us to have that
2 in there.

3 COMMISSIONER CATANACH: I think we are going
4 to allow this exhibit. But I would urge you guys to try
5 and speed it up as best you can, because, you know, you
6 are talking about finishing up by the end of the day
7 tomorrow, and I am not sure that's going to be possible.
8 I mean, it's going pretty slow and if we have continual
9 objections to every exhibit and the testimony, it's
10 going to be a lot longer.

11 MR. LAKINS: Understood.

12 MS. MARKS: Mr. Chairman, is this witness
13 going to be here tomorrow? I will have questions --

14 MR. LAKINS: Oh, yes.

15 COMMISSIONER CATANACH: I'm sure he's going
16 to be here tomorrow.

17 MR. LAKINS: And depending on how late we
18 want to go tonight --

19 COMMISSIONER BALCH: Five o'clock is
20 Florene's bedtime. And I think some attorneys have to
21 pick up their children.

22 MR. ROGERS: Attorneys don't have children.

23 COMMISSIONER BALCH: Spawn.

24 MS. MARKS: Bill, get rid of him.

25 MR. LAKINS: So this will be Exhibit Y, move

1 this slide for Exhibit Y.

2 COMMISSIONER CATANACH: Exhibit Y will be
3 admitted.

4 (AmeriCulture Exhibit Y was offered and
5 admitted.)

6 BY MR. LAKINS (cont'd):

7 Q. Mr. Witcher, in summary of this slide, give us a
8 real quick recap, highlight point what does this say?

9 A. It says that there is no magma body, there is no
10 250 degrees C resource, there is no transport of water
11 from the southwest to some structure that's trending
12 northeast.

13 The water that is flowing upward in the upflow
14 zone of this geothermal system is meteoric water that
15 has been heated. It is under advective transport, which
16 means it's recharged at high elevation.

17 And it is the water table differences that are
18 driving it deep and back to the surface up vertical
19 fractures.

20 It comes into contact with shallow ground water
21 in the outflow plume, and it mixes. And then you have a
22 minor amount of boiling that takes place there, at about
23 250 degrees Fahrenheit, 230 degrees Fahrenheit. And we
24 see a shift in the isotopes that show that. And then it
25 continues and flows on out the outflow plume to the

1 north.

2 Q. And what I want to take you to is this slide
3 here, which is from the original, and could you tell me
4 why you included this slide in the information, why it
5 is pertinent?

6 A. Well, it would be good to give a framework on the
7 slide earlier before we get to that, but I will just
8 cover it right now. And we'll just refer back to that
9 and I will point what I was pointing out.

10 The oxygen 18 and oxygen 16 ratio information
11 that was plotted in that diagram, so that's the other
12 step. And that's already been there.

13 But the important thing that I wanted to look at
14 here was the carbon isotopes, stable isotopes, carbon 13
15 versus carbon 12, and the carbon 34, sulfur -- or the
16 sulfur 34, sulfur 32 and the strontium 87/86 ratio
17 isotopes.

18 The carbon isotopes are too low for water to have
19 flowed through a Paleozoic carbonate rock. And let me
20 tell you what the importance of that little concept is,
21 is the bulk of the rock in the upper crust out there,
22 once you get beyond the volcanics, is Paleozoic
23 limestone. You are in a feature called the Pedrogosa
24 Basin. And it's very thin in that region.

25 The sulfur isotopes show that that water has

1 never been in contact with Paleozoic rocks either. They
2 have completely different ratios. In fact, the oil
3 industry uses some of these sorts of things to tie down
4 where this water's been moving also.

5 Q. Why is that important here?

6 A. Well, it is important here because the sulfur
7 isotopes indicate that this water has never flowed
8 through a limestone, it's never been in a reservoir or
9 in contact at high temperature with a limestone.
10 Otherwise, it would have picked up evaporite, oceanic
11 evaporite type sulfur isotopes.

12 The sulfur isotopes here, there's very little
13 variation and the sulfur isotopes, they plot in a
14 magmatic field, which tells me that the sulfur came from
15 an igneous intrusive type situation. And it probably
16 came from trace amounts or small amounts of accessory
17 pyrite that precipitated as the -- or crystalized out as
18 the magma cooled. And then it was later oxidized and
19 then it went into solution. And that's what we're
20 seeing.

21 The strontium isotopes say that this water had to
22 circulate in Precambrian granite to great depth or it
23 had to circulate through really high potassium, high
24 silica rhyolite to great depth.

25 And so the Precambrian rocks, that forms the bulk

1 of everything beneath the limestone. The intrusive
2 rocks, like the Muir Cauldron over there, that would be
3 the rhyolitic rocks.

4 Don't have enough information with what I have
5 done here to tell you which is which, but that pretty
6 much tells you what the flow path is and what the
7 residence history of where this water has been.

8 This tells us something about what's permeable
9 out there and what's not permeable.

10 The Paleozoic limestones out there are not
11 carrying or storing hot geothermal water. The isotope
12 information tells you that that's exactly the case for
13 the Lightning Dock Geothermal system.

14 So we can eliminate an area of high permeability
15 in the Paleozoic limestones.

16 Q. And that is important why?

17 A. That is important because there is no input of
18 water out of the Paleozoic limestones and that's why
19 they have not been -- or Cyrq has not been successful
20 with their deep wells in getting the proper permeability
21 to go over to their upflow zone resource that they have
22 they're tapping and injecting into right now.

23 Q. What does that tell you about the current
24 proposed --

25 A. What that tells me is they have to inject shallow

1 to make it work, and that's the bottom line there.

2 Q. What do you mean?

3 A. Well, they are not going to be able to get the
4 fluid to go into the ground without putting enormous
5 amounts of pressure and creating new fractures unless
6 they inject shallow.

7 Q. Do you have an opinion about whether the current
8 proposed injection zones, 150 to 1,500 feet and their
9 well locations, that the injected fluid would reach the
10 production well?

11 A. Run that question by again.

12 Q. Do you have an opinion, based upon the proposed
13 applications of their locations, which are shown up
14 here, and their depths, the proposed injection depths
15 150 to 1,500, and what you know about the subsurface
16 geology, what's your opinion about whether or not the
17 fluids being injected at those proposed sites, would
18 that fluid make it to the production zone; what's your
19 opinion?

20 A. I don't believe it would.

21 Q. Why not?

22 A. There is not enough permeability for it to get
23 over there.

24 Q. Give me a brief explanation of this slide.

25 A. This is just a cartoon to illustrate a concept.

1 And that concept is, is that we have an aquitard, which
2 is the purple, and you could think of that purple as
3 being some of the Andesitic volcanics that are in the
4 area. And you could think of that as being the
5 Paleozoic limestone.

6 And you could think the hydrologic window is a
7 fault zone that has a sufficient fracture damage zone
8 around it or it could be a silicic intrusive of some
9 kind that is highly fractured that allows the hot water
10 to flow towards the surface.

11 Q. Is that to scale?

12 A. No, it is not. It's a cartoon. It's a concept.
13 And then that hot water flows to the surface and it then
14 mixes with shallow ground water and then forms an
15 outflow plume that is in concert with the regional
16 ground water flow direction.

17 Q. And from your knowledge, this boundary between
18 the shallow and the aquitard, approximately what is the
19 depth of that shallow aquifer?

20 A. That varies. It depends upon whether you are in
21 the Horst Block or whether you are in the basin.

22 Q. Do you know what it is at the proposed locations?

23 A. I do not.

24 Q. Can you give us an average --

25 A. The reason I can't give you an average and I

1 can't give you a location on that is because I don't
2 have their data that they have collected to be able to
3 make that estimate. I just know it is there. And the
4 reason I know it is there is the core hole that we
5 drilled right here.

6 Q. Is that this one?

7 A. That is hole, yes.

8 Q. That is AmeriCulture's well?

9 A. The Americulture No. 2 Well. And a lot of that
10 well was drilled with core, so I know exactly what the
11 rock units are and what their permeable characteristics
12 are, because it preserves the fractures and what's in
13 the fractures.

14 The Paleozoic limestone that's out in this area
15 has a lot of fractures in it, but the fractures are
16 filled with mineralization. They are typed. And we
17 weren't able to move any water around in there.

18 The best permeability was up in the fractured
19 silicified basin fill or Gila conglomerate unit, which
20 is second or third unit you see down from the top. It's
21 dark.

22 And then the units below that, the ash flow
23 tuffs, they were fairly permeable also.

24 Q. Is there a fair amount of the geology known to
25 you out there that the layers are impermeable?

1 A. We just covered the Paleozoic units. They're
2 probably fairly impermeable.

3 Q. Talk to this slide real quick.

4 A. This is a geologic cross section based upon what
5 well data I could gather. And it is somewhat sketchy.
6 But I was able to get enough to see the major rock units
7 and see where the major structures were.

8 The Animas Valley fault, that's been mapped at
9 the surface. The fault on the far east, that's the
10 eastern side of that hot wells Horst Block. And that's
11 more of a gravity interpretation.

12 And between AMC-2 and 52-7, that's where that
13 fault is derived from, is basically cutting the distance
14 between, and looking at the gravity data that is
15 available for the area.

16 Q. Go ahead.

17 A. And then out to the west, 12-7, and 52-7, there
18 was sufficient information there to infer a fault there.
19 So what you have is a stepped block rising into the main
20 Horst Block.

21 Q. Now, this next slide here, this location of
22 reserves, talk to that.

23 A. Okay. What we are looking at here, all these
24 wells that are drilled out around 55-7 and 45-7, they
25 are less than 300 degrees Fahrenheit, as best I can

1 tell, with the information that I can tell. And all the
2 other wells around there, they either don't take very
3 much fluid or they have just been abandoned.

4 So I interpret that as this geothermal system
5 covers a very small area. It's probably less than a
6 kilometer square at the surface. And that's what I am
7 mapping here. And it is centered on that west side
8 fault zone right there.

9 And this would be a cross section looking in the
10 subsurface. The blue is the Paleozoic limestone. The
11 JKVG, that's the Bisbee group of sediments, which is
12 basically rift fill from that earlier rift zone.

13 And then the tertiary volcanics would be the
14 rhyolite units and the andesite units not broken out.

15 The QTGC, that's the orange color. That's
16 silicified basin fill. That's where the outflow plume
17 is for this system. And that is what caused that
18 silicification to take place. It silicified with
19 quartz.

20 Then there's 55-7. That's the injection well.
21 And I don't show the intervals where they are injecting,
22 but it's roughly outlined where that black circle is.

23 45-7, I have very little information on that. I
24 just know they got into tertiary volcanics. And they
25 are producing out of that.

1 And that's basically where the production is
2 taking place and the injection is taking place. And
3 that may be the size of the productive reservoir with
4 everything that I can pull together. So it's a very
5 small geothermal system.

6 Q. So this Q2GC, that's the alluvium?

7 A. Yes, that's the alluvium. I call it Gila
8 conglomerate.

9 Q. That is where the outflow plume is?

10 A. The outflow plume, as best I could tell, is
11 mainly in the Horst Block. Because as far as I know
12 from anything that I've seen on available well
13 information, that's the only area that has silicified
14 through the conglomerate.

15 I am not aware of 45-7 encountering anything
16 like -- or 36-7. That information is all kept top
17 secret. But I don't think that's what the case is
18 there.

19 MR. LAKINS: I am kind of just wondering how
20 much longer the Commission wants to go here.

21 COMMISSIONER CATANACH: How much longer do
22 you have on direct?

23 MR. LAKINS: It's going to be a lot, at
24 least an hour.

25 COMMISSIONER CATANACH: I guess we should go

1 ahead and break then. Let's reconvene at 8:30.

2 MR. LAKINS: Very well, sir.

3

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5 (Time noted 5:05 p.m.)

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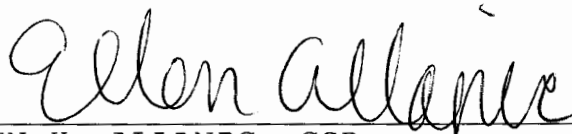
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 2) ss.
 3 COUNTY OF BERNALILLO)
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