STATE OF NEW MEXICO

ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT

OIL CONSERVATION COMMISSION

IN THE MATTER OF THE HEARING CALLED BY THE OIL CONSERVATION DIVISION FOR THE PURPOSE OF CONSIDERING:) CASE NO. 11,996

APPLICATION OF PENDRAGON ENERGY PARTNERS, INC., AND J.K. EDWARDS ASSOCIATES, INC., TO CONFIRM PRODUCTION FROM THE APPROPRIATE COMMON SOURCE OF SUPPLY, SAN JUAN COUNTY, NEW MEXICO

ORIGINAL

REPORTER'S TRANSCRIPT OF PROCEEDINGS, Volume V

COMMISSION HEARING

BEFORE: LORI WROTENBERY, CHAIRMAN
JAMI BAILEY, COMMISSIONER
ROBERT LEE, COMMISSIONER

August 20th, 1999

Santa Fe, New Mexico

This matter came on for continued hearing before the Oil Conservation Commission, LORI WROTENBERY, Chairman, on Saturday, August 21st, 1999, at the New Mexico Energy, Minerals and Natural Resources Department, Porter Hall, 2040 South Pacheco, Santa Fe, New Mexico, Steven T. Brenner, Certified Court Reporter No. 7 for the State of New Mexico.

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I N D E X

August 21st, 1999 (Volume V)
Commission Hearing
CASE NO. 11,996

(Continued...)

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SURREBUTTAL WITNESSES:

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Whiting/Maralex	Identified	Admitted
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A P P E A R A N C E S

FOR THE COMMISSION:

LYN S. HEBERT
Deputy General Counsel
Energy, Minerals and Natural Resources Department
2040 South Pacheco
Santa Fe, New Mexico 87505

FOR PENDRAGON ENERGY PARTNERS, INC.,
PENDRAGON RESOURCES, L.P.,
and J.K. EDWARDS ASSOCIATES, INC.:

MILLER, STRATVERT and TORGERSON, P.A.
150 Washington
Suite 300
Santa Fe, New Mexico 87501
By: J. SCOTT HALL
and
CARLA PRANDO

FOR WHITING PETROLEUM, INC.,
and MARALEX RESOURCES, INC.:

GALLEGOS LAW FIRM
460 St. Michael's Drive, #300
Santa Fe, New Mexico 87505
By: J.E. GALLEGOS
and
MICHAEL J. CONDON

ALSO PRESENT:

ERNIE BUSCH
Geologist
Aztec District Office (District 3)
NMOCD

* * *

WHEREUPON, the following proceedings were had at 8:30 a.m.:

CHAIRMAN WROTENBERY: Okay, we'll get started again, continue with Mr. Robinson's testimony.

BRADLEY M. ROBINSON,

the witness herein, having been previously duly sworn upon his oath, was examined and testified as follows:

DIRECT EXAMINATION (Continue)

BY MR. GALLEGOS:

Q. Mr. Robinson, I want to refer you to Mr. Cox's Table C Number 1. It was set forth within his written testimony, but I also handed out copies of that to help the Commission refer to it.

Remind us, what were his key rock-property parameters that he used in order to do his pressure-response time study?

A. Well, the key parameters are permeability and the porosity-compressibility product. Those are the ones that have the most influence over the time that it takes for a transient to move through a reservoir.

Q. Okay. Are those two properties independent? That is, if one changes the other does not change? Or are they interdependent?

A. No, they're basically independent.

Q. All right. Also, he used a particular thickness value. Is that of as much consequence to the outcome of one of these studies as the other two properties?

A. It has no bearing at all on the true transient response time now. Mr. Cox claimed that the thickness of the formation affected what he called a pressure-response time, and that's his definition. I've never heard the definition as he used it, which was the time that it took for the pressure at the surface to increase 2 to 4 p.s.i. I think that's where I wrote down in my notes, it's his definition.

If you pick up any book on pressure-transient analysis, that thickness doesn't enter into the transient response time at all. He just came up with his own definition to be able to make that statement.

So thickness doesn't really enter into it.

Q. Okay. What is the accepted, scientifically accepted, definition of pressure-response time?

A. It's the time that it takes for a pressure transient to move a specific distance in a reservoir.

Q. Now, referring to his table, what did he show as the properties in terms of permeability between the Fruitland Coal and the Pictured Cliffs sandstone?

A. Well, he estimated the permeability for the coal to be 20 millidarcies and the Pictured Cliffs to be 150 millidarcies.

Q. And are those the correct permeabilities for those formations in this area?

A. No. In fact, if you use the actual available data, those numbers should be reversed. It should be more like 150 millidarcies for the coal and maybe 20 millidarcies for the Pictured Cliffs.

Q. And if you use those corrected permeabilities for those formations, what does that do to his conclusions regarding where the communication exits between these formations?

A. Well, exactly -- It makes them opposite. So where he said communication existed in one well, it's the opposite of what he said.

Q. So the conclusion would be what, then?

A. That the communication exists in the Chaco wells.

Q. Is that influenced, or that effect mitigated by the compressibility numbers that he uses? In other words, does that change that reversal of the conclusion?

A. No, the compressibility numbers are independent of permeability, as I said. So those numbers stay the same, they don't have to change. So that conclusion is independent of the porosity-compressibility.

Q. In fact, did he change the compressibility-porosity number on the Fruitland Coal later in his analysis?

A. Yes, he did. He recalculated it, as you can see on the next page, and he described that where his compressibility-porosity product is about .0018, which is essentially the same as it's going to be in the Pictured Cliffs. So that part of the equation actually cancels each other.

Q. All right, let's go to another subject of Mr. Cox's testimony. In this case, when we see the decline curves observed on not only the Chaco Pictured Cliff wells but essentially all the wells in this WAW-Fruitland-Pictured Cliff field, we see a rather sharp decline down to basically noneconomic production.

Whiting says that's because the reservoir is depleted.

Pendragon says that's because of damage.

Now, Mr. Cox says there are only two explanations, it's either depletion or damage. First of all, do you agree with that?

A. No, there's more than two explanations, very easily. A third explanation might be a dual-porosity system, such as a naturally fractured reservoir.

Another alternative, which is really the one we came up with, and that is a moderate-permeability reservoir, say 25 to 30 millidarcies, with a slight amount of damage. We can reproduce the production history on all those wells with, you know, that type of model.

So there's really four different ways you could reproduce that history. It's not a unique solution by any means.

Q. All right. Let's discuss what is proposed by Pendragon, particularly Mr. Cox and also Mr. McCartney, about damage. First of all, do you understand their testimony to be that the supposed damage is not confined to around -- near the wellbore, but is throughout the entire reservoir?

A. That's what I heard him say, yes.

Q. Okay, is there any damage mechanism recognized in the industry that you've seen that would cause a reduction in permeability throughout an entire reservoir?

A. The only damage mechanism that I know of that could cause that is formation compaction, and this can occur in softer, compressible rocks like we see along the Gulf Coast. When you have a real soft formation, and as the pressure is depleted in that reservoir, the overburden literally squishes the rock, because it's so soft, and reduces the permeability, is what we call formation compaction.

But you've got to have two things. Number one, you've got to have pressure depletion, substantial, and number two, you've got to have soft rock. And of course that directly conflicts with what their experts say exists here. Mr. Nicol says it's a hard, brittle rock, and Mr. McCartney says pressure depletion isn't occurring in any substantial amount.

So if they had come up with that idea as a means to reduce permeability in the whole reservoir, I'd have bought it. But these other explanations, I can't -- They just don't exist.

Q. Well, if you have compaction and you've lost pressure and lost permeability, if you fracture-stimulate a well is that going to overcome --

A. No.

Q. -- that circumstance?

A. No, fracture-stimulation doesn't repair the permeability, it only creates a conductive flow path for the gas or oil or water or whatever to be produced into the wellbore. So it doesn't repair the permeability at all.

And if compaction had occurred -- I think Mr. McCartney actually made some calculations where he showed the permeability in the reservoir could have reduced to, say, 10 percent of the original value, which would have put the permeability of the Pictured Cliffs on the order of 3 to 5 millidarcies, something like that. He made those calculations to reproduce the behavior of the Chaco wells. And like I said, if that's due to formation compaction I can buy it.

Number one, that makes almost all of Mr. Cox's calculations wrong, because he's using a permeability for the Pictured Cliffs which is a factor of five or ten too high.

And number two, any projections you make of future performance have to be based on that lower permeability, 3 to 5 millidarcies, not 25 millidarcies like Mr. McCartney did in his Exhibit M-26, but 3 to 5 millidarcies. Completely different reservoir performance after fracture-stimulation.

Q. Mr. Cox offered, quote, "water block" as his theory of the reservoir damage in the Pictured Cliffs sandstone. Do you know what that means?

A. Yes, I do know a little bit about water blocks. In fact, when I was at Texas A&M University, I performed research for Dr. Holditch on the factors that control what causes water blocks. And I was also project manager for a Gas Research Institute project where we studied that very phenomenon. So I definitely know what water block is and what can and can't cause it, you know, so I'm very familiar with that terminology.

Q. Okay, and what do you see in the evidence here that points toward the existence or nonexistence of water block as being an explanation for the reduced productivity of the Pictured Cliffs reservoir?

A. Well, like I said yesterday, it just can't occur under these reservoir conditions. Let me hold up a log section on both the Chaco 4 and Chaco 5. This shows --

Q. BR-30?

A. This is BR-30. This shows the top of the Pictured Cliffs here, and what I've colored in as yellow in both wells is the gas-saturated portion of the Pictured Cliffs, in my opinion.

And what I've shown down here in blue is the higher-water-saturation interval, which everybody's calculated exists, water saturations on the order of 75 or so percent. Everybody agrees that this is tighter reservoir down here in the lower part of the Pictured Cliffs. If you look at the logs, the clay content is approaching 50 percent. High clay content, lower permeability.

That means that the capillary pressure in that part of the reservoir has to be much higher than the capillary pressure up here at the top where you can have a higher-permeability part of the reservoir.

Now, first of all --

Q. And higher capillary pressure means what in terms of water migration?

A. Capillary pressure is what holds the water in place, basically, in a simple point of view. So the higher the capillary pressure, the more water that rock can hold. Sponges have very high capillary pressure, they absorb water and hold it. So that's -- Rocks also exhibit that property.

Now --

CHAIRMAN WROTENBERY: Mr. Gallegos, do you have copies of BR-30?

MR. GALLEGOS: No, we don't.

CHAIRMAN WROTENBERY: Okay.

MR. GALLEGOS: We just have that demo. It's hard to see from there, isn't it?

CHAIRMAN WROTENBERY: It is kind of hard to see.

THE WITNESS: Do you want me to move it up?

MR. GALLEGOS: I think if you --

THE WITNESS: Here's the yellow portion that could be a transition from gas to water in this region. Here we see this curve for the falloff, and then this is basically water-saturated down here at the bottom. Okay?

So when Mr. Cox was asked, where's the water coming from, he didn't say. He said in his testimony it could be coming from down here in this lower-permeability part, but in his testimony the other day he said it could be flowing from up here in the higher-permeability part. Now, let's look at each one of those individually.

If it's coming from down here, he's saying the water is flowing from an area of high capillary pressure to an area of low capillary pressure and stopping there. And in reservoir engineering, that can't occur. Water doesn't flow to an area of low capillary pressure and suddenly stop. It can't happen.

The second thing he said was, well, maybe it's flowing along in the higher-permeability zone. Well, again, if it's flowing in the high-permeability zone, why would it stop? Why would it suddenly stop and form a water block? It can't happen.

So that explanation is just wrong. We've done a lot of research, and if there is mobile water, a water block cannot form, period, end of story. It cannot happen if there is mobile water saturation.

Q. (By Mr. Gallegos) Okay, let's say that you're an operator of these Pictured Cliff wells, and just assume some form of damage. There's other recognized forms of damage besides water block, correct? You mentioned something about that last evening.

A. Yes.

Q. Scaling and so forth.

Let's assume you're an operator of these wells and they've gone down -- produced and then gone down a depletion curve, and you think, well, maybe there's more gas there, I think there's damage.

Doesn't the industry have methods to test the well instead of speculating that it's this or that, to actually do certain tests to determine whether, in fact, it's depletion or damage that's caused the reduced production?

A. Yes, they do, and there are many different types of analysis methods, you know, pressure-transient tests. The injection falloff tests that Whiting performed is one method. You can analyze production data, a very cost-effective, inexpensive method of analysis to try and estimate the amount of damage that might exist in a reservoir. You don't have to buy real expensive programs or simulators to try and analyze damage; there's very inexpensive ways to do that.

Q. Have you seen any evidence in the well files or brought forth in this proceeding anyplace that before going in and fracturing these Chaco wells, efforts were made to do tests to determine, are they nonproductive because of depletion reservoir, or because of reservoir damage?

A. No, I haven't.

Q. Has all that we've seen been an after-the-fact explanation, after the wells were fractured and had these high production values, as to the supposed existence of damage?

A. That's correct.

Q. Okay. And that has been without any specific test; isn't that true?

A. That's true, there still hasn't been any test.

Q. Okay. Now, did Mr. Nicol present any kind of quantification of the damage, that it was two feet out or -- any quantification?

A. Not that I heard of in his testimony.

Q. Did Mr. Cox attempt to present any quantification of the damage?

A. No.

Q. Okay. Now, Mr. McCartney did, did he not, do some sort of a study?

A. Mr. McCartney did attempt to calculate the reduction in permeability that might occur throughout the reservoir that would help explain the decrease in production. But his model, as best I can tell -- and I stand corrected if he tells me I'm wrong -- he calculated the permeability reduction throughout the entire reservoir, not just around the wellbore.

Q. Okay, was that in his Exhibit M-25?

A. Yes.

Q. And what is your opinion as to the validity of calculating reservoir damage, not as a factor of a phenomenon around the wellbore but throughout entire sections and sections of reservoir?

A. Well, it's like I said before, there is one damage mechanism that I would believe that could explain a reduction in permeability throughout the reservoir, but obviously they didn't know about it or they chose not to bring up that possible damage mechanism, because it would directly conflict with what their other experts are saying.

Q. Could any other damage mechanism affect the entire reservoir?

A. There's none that I know of, but I mean anything's possible in the petroleum industry, but I've never seen or heard of any other.

Q. Okay. On the Chaco 4, there's been considerable discussion about the change in pressure in early 1995. If I remember correctly, a reading, I think, January 30, 1995, 117 pounds, acid job done after that, and then a jump in pressure to 170 pounds. Do you recall that?

A. (Nods)

Q. I think one or more of their witnesses has said that acidization overcame the reservoir damage and therefore resulted in the pressure increase. Do you agree?

A. No, I don't agree at all. I mean, everything we've heard from them describes extremely deep damage, damage that goes far out in the reservoir. So even though nobody's calculated how deep that is, I mean, it certainly gives me the impression that it's tens of feet, if not hundreds of feet, of damage.

It would have to be hundreds of feet before they could claim there's no test available to determine how bad it is. I mean, if it's ten feet, all these tests we mentioned earlier can easily identify and quantify the amount of damage. If it's hundreds of feet, then, you know, maybe a test would be questionable. So it's got to be hundreds of feet, or at least that's the impression I'm getting.

Now, the acid job they pumped was 500 gallons. I went back to my hotel room the other night, and I calculated how deep that acid would penetrate the formation, and it's two feet, is how far that acid got out into the formation. Well, if they've got this extremely deep damage, that acid would have never even got through it. And so there's no way that it could have encountered some higher-pressured part of the Pictured Cliffs out there, you know.

Q. With the 500 gallons of acid applied to that well, to what extent would you expect the reservoir to be affected in terms of inches or feet?

A. Well, like I said, I calculated two feet was the radius of depth that the acid would penetrate.

Q. Mr. Cox's interference calculations made an observation, as I understand it, that a jump in pressures at the Chaco wells of 10 or 12 or 15 p.s.i., when the Gallegos Federal wells have shut in, could only be explained by communication existing as a result of fracturing the Whiting wells. Do you agree?

A. No. No, not at all.

Q. Is there another very obvious explanation?

A. Well, the obvious explanation is that communication is really in the Chaco wells. Of course, if you use the correct permeabilities that's the conclusion you come to, based on Mr. Cox's calculations.

Let's look at that. To save time, I had this -- This isn't an exhibit, it's just something I wanted to illustrate with.

Q. Isn't it a modified version of your --

A. BR-26, yes, and I believe we did --

Q. Slightly changed BR-26?

A. Slightly changed BR-26 -- I guess it is called BR-26 (a) now. And the change is, I said okay, let's suppose Mr. Conway -- Dr. Conway -- If I just say Michael, will everybody know what I'm talking about?

Let's suppose Dr. Conway is correct, and a fracture grew up and stopped at the base of the Fruitland Coal in a Chaco well, and this is a Pictured Cliffs completion. Since Mr. Gallegos mentioned Chaco 4, we'll make that Chaco 4.

And over here on the right-hand side we've a Gallegos Federal well, and the 6-2 seems to be the well of choice for this proceeding, so let's put 6-2 over there.

Now, what we see is, this is the pressure, shut-in pressure, at the bottom of the hole on the Chaco 4, and that's 80, 90, 100 p.s.i. It doesn't really matter. Let's just put 80 p.s.i. there, because that's what I think it is. But they disagree.

Now, we're producing this coal well over here, and if its fracture has grown down into the Pictured Cliffs it will look something like that. And this is a vertical fracture, maybe a quarter to a half inch wide, that's creating a path down into the Pictured Cliffs.

Now, let's say this well is flowing. This P_{wf} represents the flowing bottomhole pressure. Let's use a number of 20 p.s.i. Okay? Something like that. It could be a little lower, could be a little higher, depending upon whether you got water in the well and, you know, the well is being pumped off and so forth.

This is what happens while the well is producing. I believe you will recall there's been several graphs shown on the Chaco well of pressure versus time. That pressure is slowly declining with time.

COMMISSIONER LEE: Can you specify the p.s.i.a.

or p.s.i.g.?

THE WITNESS: I'm sorry, let's say p.s.i. -- doesn't really matter. To this illustration it does matter, of course. Let's say p.s.i.a. Okay.

In that case, I probably should make this a little higher. I'll make this 30. That's for the coal well.

All right, so in a producing condition there's a pressure gradient that exists from this well over to this well. And this is a simple two-well model, recognizing there's other wells out here that may or may not be influencing the pressures. But let's just look at this well.

So somewhere, some distance -- There's 50 p.s.i. difference between these two wells, all right? So some distance, pressure here is about 70, at some distance closer it's 60, at some distance here it's 50, and at some distance here it's 40, till you get over to the coal well where it's 30. Okay?

Now, we suddenly shut in this Whiting well, this Gallegos Federal 6-2. What's going to happen on the Chaco 4? Well, it's going to continue to decrease for a while. It will eventually flatten out, and if these are the only two wells in the system, it would level out at some average pressure that exists in this reservoir here, in the

Pictured Cliffs. Okay? And it might be 70 pounds or 60 pounds or something like that, whatever the average reservoir pressure would be.

Now, to see a 10-p.s.i. pressure increase in that well, what we have to do is start filling back up the Pictured Cliffs. We've got two tanks here, and here's the valve for the tank, over here on the Whiting well, if you believe their experts.

So to see a 10-p.s.i. increase over here, we've got to fill up this entire reservoir between these two wells. And actually, there's more reservoir over here, and there's really more reservoir over here.

So the Whiting well is producing, it's making gas. Now we shut it in. Mr. Cox wants us to believe that that gas is crossflowing down here and is filling up the Pictured Cliffs, which was gas that was coming to here. Now, it's going to go that way, there's going to be some that goes into the bore and then some that goes out of the bore.

So you've got probably 160 acres here and 160 acres there, 300 or so acres, that that Whiting well has to fill up and increase the pressure in the Chaco well 10 p.s.i. Well, that's directly proportional to the amount of gas in place. And that's how Mr. Cox gets away with his definition of pressure response time and why it's a function of thickness.

So my estimate of the remaining gas in place in this Chaco 4 was about 66 million cubic feet something like that. And let's assume there's another 66 million over there around the Whiting well, so that makes a total of about 120 million cubic feet of gas at some average reservoir pressure, 70 pounds, 80 pounds, doesn't really matter.

Now, to increase the pressure in this well 10 p.s.i., we have to inject roughly 10 to 12 percent of the gas in place in a 24-hour period. That means we have to inject 10 percent of 120 million, or 12 million cubic feet per day, from this Whiting well.

It only produces 500. How can this Whiting well repressurize the Pictured Cliffs 10 p.s.i. when it's only capable of producing 500? It has to inject tens of millions of cubic feet of gas per day.

Now, you know, I just don't think that can happen. Physically, it's impossible.

What if our fracture exists over here in the Chaco well? Okay, same thing. We've got 80 p.s.i. average here. That's in the coal. We've got 50 -- or 30 p.s.i. over here --

Q. (By Mr. Gallegos) And now we've got a fracture in the Chaco well that's up into the coal?

A. We've got a fracture over the Chaco well up into the coal.

Let's do the same thing on the other side. Let's assume the Whiting well does not extend down into the Pictured Cliffs. Whiting well is producing, got 80 p.s.i. over here.

Now, all the pressure gradients are going towards the Whiting well, all the gas and water is basically flowing towards the Whiting well, and we shut that Whiting well in. What happens? Well, gas starts -- continues to desorb off the coal, because there's still lower pressure in the coal. When that gas desorbs, it increases the pressure in the reservoir.

The only way that increase in pressure can be seen here at the Chaco well is direct communication at the Chaco well. It's the only way to see a 10-p.s.i. pressure increase is due to the additional gas that desorbs, because when that gas desorbs it pressurizes the formation through gas expansion.

MR. GALLEGOS: We conclude our direct, move the admission of Mr. Robinson's prefiled testimony, his Exhibits BR-1 through -30, and pass the witness for cross-examination.

CHAIRMAN WROTENBERY: Okay. We would like to get a copy of BR-30 in a more convenient size --

MR. GALLEGOS: Yes, we'll --

CHAIRMAN WROTENBERY: -- if you could supplement the record with that information.

MR. GALLEGOS: We'll do that.

CHAIRMAN WROTENBERY: Okay. And, yeah, we'll accept his prepared direct testimony and admit Exhibits BR-1 through -30.

MR. GALLEGOS: And I guess we need to add a -26 (a), because that's not in the packet, so --

THE WITNESS: Right.

MR. GALLEGOS: -- so my -- And we'll provide an 8-1/2-by-11 copy --

THE WITNESS: Actually, I do have --

MR. GALLEGOS: Do you have --

THE WITNESS: -- smaller copies of that.

MR. GALLEGOS: Good.

THE WITNESS: I did bring those with me, because that was a real important...

CHAIRMAN WROTENBERY: Mr. Hall, I was moving so fast I didn't ask you if you had any objection.

MR. HALL: No objection.

CHAIRMAN WROTENBERY: Okay. I also wanted to ask before we get into the questioning, Commissioner Lee had asked for some information from Mr. Robinson on the FRACPRO model, which you have provided. Do you have any problem if we mark that for identification --

MR. GALLEGOS: No.

CHAIRMAN WROTENBERY: -- as BR- --

MR. GALLEGOS: -- -31.

CHAIRMAN WROTENBERY: -- -31?

Mr. Hall, do you have any objection if we include BR-31 in the --

MR. HALL: No objection.

CHAIRMAN WROTENBERY: -- record?

MR. GALLEGOS: Don't want my letter in there.

CHAIRMAN WROTENBERY: Yeah, I've got it. I'll just put that aside.

THE WITNESS: Oh, you know what, Gene, I left those on your conference-room table. I'm sorry.

MR. GALLEGOS: Okay, we'll provide those, if we might, Madame Chairman, a little later.

CHAIRMAN WROTENBERY: That's fine.

Mr. Hall?

CROSS-EXAMINATION

BY MR. HALL:

Q. Good morning, Mr. Robinson.

A. Good morning.

Q. Let me ask you some questions about your prefiled testimony. On pages 5 and 6 you discuss the --

A. Excuse me, could I get a copy of that? I don't have one in front of me. Okay.

Q. What pages 5 and 6 discuss are the use of the 1.0 fracture gradient for the Pictured Cliffs, and in your table you show that normal fracture gradient for the PC ought to be in the range of .4 to .6 p.s.i. per foot. Do you see all that testimony there?

A. Yes.

Q. What's the source of the data for the .4 to .6 frac gradient range?

A. I got that from Palmer, Johnson and also -- Well, I can't think of the other source now. Well, and the fourth method was based on some work I had done for GRI. Then I made a correction for pressure depletion --

Q. Okay.

A. -- which we all know exists in this reservoir.

Q. Is any of that data derived from any work you've done on some actual wells in the Basin?

A. Yes.

Q. Give us a general idea about those wells, where they are, if you can recall.

A. I don't remember. There was a study that I did for the Gas Research Institute about four or five years ago. I don't remember the wells.

Q. Okay. Let me show you an article here. You mention Dr. Palmer. I hand you what's been marked as

Exhibit Robinson-1.

COMMISSIONER LEE: Can I say something about this?

MR. HALL: Yes.

COMMISSIONER LEE: You know, older SPE papers are not refereed papers. Whenever you have SPE Number 21811, that doesn't mean this is a refereed paper.

Any objection?

THE WITNESS: By "referencing" -- a reference paper?

COMMISSIONER LEE: No, refereed paper.

THE WITNESS: Refereed, I don't know, sir.

COMMISSIONER LEE: Nobody cross-checked?

MR. HALL: You mean subject to peer reviews?

COMMISSIONER LEE: Yes. So is the other side's SPE number --

MR. HALL: I understand.

COMMISSIONER LEE: This is not a refereed paper.

MR. HALL: I understand what you mean.

THE WITNESS: I think in the case of Mr. Palmer's work, that was published in the *Journal of Petroleum Technology*, which would have meant that it was subject to peer review. So I'll accept this paper as being subject to peer review.

COMMISSIONER LEE: Just show the regular paper.

MR. HALL: Yes, sir.

MR. GALLEGOS: Just in case, if there's any questions, I have a copy of that article.

THE WITNESS: Thank you.

MR. GALLEGOS: Just one page.

MR. HALL: Yeah, the record should reflect that Robinson-1 consists of the first page of the Palmer SPE article and Table 2. It is not the complete article.

Q. (By Mr. Hall) Let's talk about that briefly, very briefly, Mr. Robinson.

Are you aware, in this paper, anyway, that Ian Palmer restricted that lower frac gradient for use at wells at depths of 3000 feet or more? Isn't that what Table 2 in the exhibit would suggest?

A. You said 3000 feet or more. It looks like it's 3000 feet or less to me.

Q. Well, let's go through that table. If you look at the depth at the bottom there at approximately 1550 --

A. Yes.

Q. -- what's the fracture gradient he reflects there?

A. 1 p.s.i. per foot.

Q. Okay. So you'd agree that there's a basis in the literature, even Dr. Palmer's literature, for the fracture gradients that Dr. Conway has used in his simulations?

A. No. Dr. Conway used 1.15 p.s.i. per foot in the coal, not in the Pictured Cliffs.

Q. Well, that's what I meant to say, in the coal. I didn't specify the formation, but the fracture gradients that he used for those depths.

A. No, not at all, because if you turn over to Figure 1 in that same paper, you see it as the stress gradient in the coal is 0.9 p.s.i. per foot.

Q. Let's look at, back on page 6, lines 8 through 13. You discuss generally the sizes of the fracture treatments that were used in this case. And I might have you refer to Sheet 1, which is part of Mr. Nicol's testimony under his page 98, there was included a Sheet 1. Would you generally compare the relative sizes of the stimulation treatments used on the coal in the Pictured Cliffs by the operators there?

CHAIRMAN WROTENBERY: I'm sorry, we didn't follow. Where --

MR. GALLEGOS: Yeah --

MR. HALL: That's under Mr. Nicol's testimony. It's not in the exhibits, but it's right after page 98, Sheet 1.

MR. GALLEGOS: We're at page -- Excuse me, Mr. Hall, we're at page 98, did you say?

MR. HALL: Following page 98.

CHAIRMAN WROTENBERY: I actually have it following page 96 in my book. I don't know if that's something I did or --

MR. HALL: That was provided the day after our filing. It should have been placed by you in your notebook.

MR. GALLEGOS: Well, I'm sorry, I didn't do that. Do you have another copy?

MR. HALL: I don't, I'm sorry.

MR. GALLEGOS: Thank you.

Q. (By Mr. Hall) I'll just ask you generally about the information shown on Sheet 1, Mr. Robinson.

Wouldn't it be fair to say that the fracture-stimulation treatments on the coal wells were three to four times the size of the treatment on the Pictured Cliffs?

A. I would say that's a fair statement.

Q. And then on page 7, line 1 and 2 of your testimony with respect to the 6 Number 2 well, you say that the fracture treatment on that well likely grew down into the Pictured Cliffs formation, correct?

A. Correct.

Q. Then on -- Go down to line 4 on that same page. you said that you modeled multiple fractures in the simulation in that well, right?

A. Yes.

Q. Would you explain to us why you ended up modeling multiple fractures for that stimulation treatment?

A. I had to model multiple fractures in order to get the simulator to predict a high enough pressure to match the actual data.

Q. Well, in doing that, how did you differentiate between the high-stress zones and the multiple fractures that you saw?

A. I guess I don't understand your question, but I didn't change anything in the properties of the layers, if that's what you're asking.

Q. Okay, so you did not --

A. No.

Q. -- differentiate? I see.

And how many multiple fractures did you determine existed?

A. Four.

Q. How did you derive that number?

A. That's the number of multiple fractures it took to reproduce the pressure in the model that we saw in the field. We tried nine, the pressures were too high. We tried two, the pressures were two low. We tried four, the pressures matched.

Q. So when you used FRACPRO there were a number of options available to you to try to derive that four-fracture model, correct? And you determined that that was the best one, based on the pressure range that you saw?

A. I guess I don't understand your question, I'm sorry.

Q. Well, what were the other data inputs that you used when you ran your FRACPRO simulator, when you finally concluded that four fractures would be appropriate? What else did you assume? What else did you input into FRACPRO?

A. We input the actual pumping schedule from the well, that included the volumes of fluid and proppant that were actually pumped. We input the actual injection rate into the simulator, because we wanted the simulator to reproduce the actual treatment that was pumped.

Of course, all the properties for all the layers that we had used in all the Chaco simulations, the Young's modulus, stress, you know, pressures in each of the -- all the physical properties of the layers that we determined exist. Those were all in there, but we didn't change those, we kept those the same.

So really the only thing I varied was the number of fractures that it took to reproduce the pressure. And of course we changed the job size.

Q. Okay. So when you're trying to achieve that pressure match, you would have the same pressure number for a single fracture, and then when you try to derive four fractures, you would divide that same pressure number by four for your four different fracture geometries, correct?

A. No.

Q. The shut-in pressures for the sand and the coal differ by about 430 p.s.i. Can you explain what varying that has, when the predicted geometries are similar?

A. Would you restate the question, please?

Q. Well, the shut-in pressures, the observed shut-in pressures -- the initial shut-in pressures after frac on the treatments for the sand and coal differ by only about 430 p.s.i.

A. Okay, the ISIPs.

Q. Yes.

A. Instantaneous shut-in pressures.

Q. Right.

A. Okay, now I'm with you.

Q. What does this mean when the predicted geometries differ?

A. Well, in the case of the Gallegos 6-2 well, it meant there were multiple fractures, and as the result of having multiple fractures in the coal, the pressure was higher at the end of the job than on the Chaco wells. And even though the geometry could be similar, the fact that there's four fractures there instead of only one causes the pressure to be higher.

Q. All right. So when you say there's an equal probability that the fracture -- for a fracture originating in the coal to break out into the PC sandstone, and vice-versa for a fracture initiated in the sandstone to break out into the coal? Is that what you're saying?

A. That's my conclusion, yes.

Q. In light of the different ISIP pressures for the two formations, which has higher probability to break out of zone? Can you say?

A. No, I think they both have the same probability.

Q. Well, explain that. Why would it be the same probability if you had different ISIPs?

A. Because the pressure inside the fracture exceeds the stress in any of the layers, and so it doesn't really matter whether that pressure is 1000 p.s.i. or 5000 p.s.i. If that pressure is higher than the stress in the layers, then the probability is the same that it's going to break out. Yeah, there's no -- It's the same.

Q. Generally you would agree that the higher stressed layers would tend to stop fracture growth, as a general principle, right?

A. If the stress in the layer was higher than the frac pressure, yes. But you can have high-stress zones that fracture will grow right through. So just because it's got high stress doesn't mean it's a barrier.

Q. Again, how -- You've run your simulator. How would you differentiate between the higher stress zones and the multiple fractures in the case of your simulation?

A. There are input data at a different screen. It's a different input in the model.

Q. All right. In the case of the simulators, both FRACPRO and GOHFER we've discussed here, both of those simulations show fracture geometries going through both the high- and low-stress zones, right?

A. Yes, I guess. Mr. Conway's didn't show the fracture growing through the coal, which is the highest stress zone in his model, but that's because the stress in the coal was higher than the pressure in the fracture.

Q. I want to refer to your Exhibit 11, the pressure plot for the 6 Number 2 well.

A. Okay.

Q. Why do all of your net pressure plots reflect a minimum observed pressure just before the end of the job of about 400 p.s.i. there, a little higher than 400 p.s.i.?

A. You mean at a time of about 34 or 35 minutes?

Q. Yes.

A. Why is the pressure slightly over 400 p.s.i.?

Q. Right.

A. Because that's what it was measured to be in the field.

Q. What do you do with that number? Don't you have to take that number and add it to the closure stress gradient at that point?

A. I don't have to, no.

Q. Well, for -- If you want to see the result where a proppant would be injected up into the coal from a fracture initiated in the sandstone, wouldn't you have to add that 400 p.s.i. number to your closure stress gradient number?

A. No, I wouldn't add that one, because this is a fracture treatment on the coal, not in the Pictured Cliffs.

Q. Well, presume for me that there was a fracture initiated in the Pictured Cliffs.

A. Okay.

Q. And you have that pressure observed just before the end of the job.

A. The net pressure is 400 p.s.i.

Q. Right.

A. All right?

Q. Presuming we're seeing a fracture penetrate up into the coal.

A. Okay.

Q. So for you to show the injection of proppant up into the coal, wouldn't you have to take the observed net pressure number and add that to the closure stress gradient for that to result?

A. It's not quite that simple, and -- For a conventional two-dimensional linear elastic model that would be true. It's not quite that simple, though.

But to get to your point, people take -- yeah, you definitely -- you add the net pressure to the closure pressure, and that gives you an approximate value for the fracture pressure, if that's your question.

Q. Okay. The treatments here on the Pictured Cliffs wells, generally you have a fracture that goes, as you say, from the bottom of the Pictured Cliffs formation, potentially, up into the coal. I mean, you have a relatively thin fluid that's used, and you have a fairly low density foam component to the fluid; is that fair to say. That's a general description of the treatments used on the PC here?

A. I wouldn't characterize the foam as a thin fluid, no.

Q. But generally, the treatments relative to the treatments used on the coal wells, you have -- a low-density foam was used, correct?

A. Define low-density foam, I'm sorry.

Q. I can't, I'm a non-engineer.

A. Okay, well I'm sorry, I can't answer that question. I don't understand it.

Q. Can you define low density for me?

A. Low density?

Q. Yeah.

A. Low density means the -- Well, I guess it's all relative. Water is low density relative to other materials. Then again, it's high density relative to gas. So I -- I don't have a definition for you, I'm sorry.

Q. Well, for the fracture treatments that we saw in the Pictured Cliffs, and assuming they penetrated up into the coal, the conditions and materials that were used here, isn't that a good set of conditions for the sand proppant to settle at the bottom of the fracture?

A. No.

Q. Why isn't that the case?

A. Well, foam is a very good proppant-transport fluid. You know, obviously if it's not mixed correctly it could be a real lousy fluid for transporting proppant. All of the fluids we use in our industry could be bad if they're not mixed properly.

You know, if I want to assume the job pumped three or four years ago was bad, I could do that. But I don't have any information on those jobs to suggest there was anything wrong. So barring any information, I have to assume the foam was mixed correctly. And if it was, foam makes an excellent proppant-transport medium. So I can't agree with that statement.

Q. Well, let's look at your Exhibit BR-12 there, fracture profile on the Gallegos Federal 6 Number 2 well. The dark area on the left side of your geometry, that shows the propped length, correct?

A. Propped half length.

Q. Propped half length. And it's almost the same size as your gross geometry shown on the right side, right?

A. That's correct.

Q. Which represents the proppant location in the formations?

A. The one on the left-hand side represents the placement of proppant in the formation.

Q. Now, Mr. O'Hare, when he testified --

A. Or in the fracture, I'm sorry.

Q. I'm sorry. When Mr. O'Hare testified about the stimulation treatments he designed and used, he said that the fluid was of a very low viscosity. Do you recall him discussing that generally?

A. I wasn't here when he testified to that, but I'm aware that he made that statement, yes.

Q. Okay. Well, what is that -- Do you agree generally with what you've seen described about the fracture-stimulation treatments on the coal wells, that they are generally low-viscosity treatments?

A. No, I don't.

Q. Why not?

A. Because the viscosity of a foam is controlled by primarily the size of the bubbles of the gas. It's what we call the texture of the foam. Now, the viscosity -- You take water and you mix it with gas and you add surfactant to make a foam. Dr. Conway described shaving cream. That's literally what we pump into these formations sometimes. Now, it's not always that fine. Shaving cream is extremely fine textured.

The viscosity of foam is a function of the texture, but it's also a function of the viscosity of the water you add. So you can reduce the viscosity of a foam by not making the water thick. You know, we add gel and polymer to make the water thicker, and then we add the gas to it, and that provides a higher-viscosity foam. It still doesn't affect the proppant-transport capability of the foam, because that's tied to texture, which is how small the bubbles are in the foam.

And it doesn't mean the foam is low viscosity. Again, that's a relative term. 200 centipoise is low viscosity relative to what we call our cross-linked gel fluid. But 200 centipoise can transport sand into a formation for hundreds of feet very easily.

So, you know, I disagree.

Q. Well, what Mr. O'Hare described in his prefiled testimony was that in his experience he had seen fracture-stimulations on coals result in damage to the coals where there was a higher viscosity, some gels, some bactericides, reduce the ability of the coal to produce gas. Do you agree with that?

A. I would agree with the comment that the addition of the polymer is potentially a damaging mechanism in the coal, yes.

Q. Now, Mr. O'Hare testified that to counteract that possible outcome he increased his volumes, reduced his viscosity very low, and injected at higher rates. Wouldn't you agree that that would result in longer fracture lengths, or at least multiple fractures, in the geometry?

A. No.

Q. In a treatment like that, as Mr. O'Hare has described it -- if we follow Mr. O'Hare's testimony, I understand you disagree with him somewhat. If you follow his descriptions of his stimulation treatments, wouldn't you expect to see some proppant settling before the fracture closed?

A. If the foam broke before the fracture closed, then there could be some proppant settling that would occur within the fracture. If the foam did not break prior to fracture closure, then I do not believe there would be any settling of the proppant. And that proppant that had been injected into the coal, I don't believe that would settle out either. That would remain in the coal.

Q. Well, is a foam more likely to break down in a lower-viscosity treatment?

A. I'm sorry, "break down"?

Q. Well, that's the term you used, if the foam broke.

A. Oh, oh, okay.

Q. Did I misunderstand your use of the term?

A. No, no, no, you understood me perfectly. I misunderstood you. I was thinking you were talking about the fracture broke down. I was thinking the fracture, and that's why I hesitated, I'm sorry.

Could you restate the question?

Q. Yeah. Isn't it more likely that the foam would break down in a lower-viscosity treatment where the foam additive is a smaller component of the fluid?

A. I don't know the answer to your question. There are a lot of factors that control the breaking of foam, so I -- Strictly, by the way you asked that question, I can't answer it, I'm sorry.

Q. Okay. Well, how does FRACPRO -- What did your simulation show? Did it show any settling of the proppant?

A. No, I don't think it did. But to be real honest with you, I do not remember.

Q. Is it capable of showing any settlement of the proppant?

A. Yes.

Q. And is that a programmed function?

A. Yes, it's part of the program, if that's what you're asking me.

Q. Well, is it a variable component? In other words, is this one of the knobs we've been talking about over the past few days?

A. No.

Q. So as I understand your BR-12, the way it's portrayed here on the propped length, it shows an equal distribution of proppant throughout the formation intervals there; is that what it shows?

A. No, that does not show an equal distribution. That picture only shows the propped length.

Q. Well, but does that presume an equalized proppant placement throughout the propped length?

A. No, it does not.

Q. Well, does it presume some settlement, then?

A. This picture does not represent the settlement of the sand --

Q. Okay.

A. -- no.

Q. Do you have any other exhibits or depictions from your FRACPRO simulation which would show placement across the fractured interval?

A. I don't have any exhibits or prints with me. I think on this particular well I do have that on my computer, and like Dr. Conway I'd be glad to print that out and present it, or we can look at it on my computer screen.

Q. Well, just so I understand the concept in the real world, and even in your simulator, proppant is not concentrated equally across the fracture geometry, correct?

A. That is correct.

Q. There would tend to be some settling, correct?

A. If the fluid were not a perfect transport medium there could be settling, yes.

Q. And settling implies downward settling due to gravity, right?

A. Correct.

Q. So a fracture initiated in the Fruitland Coal with some proppant, the proppant, were it to grow out of the Fruitland Coal, you would see more proppant end up in the formation below, correct?

A. The volume of the proppant below would be greater, yes. The concentration of the proppant may or may not be greater.

Q. Well, why not? What would account for the difference?

A. Well, you just said, if the majority of the fracture grew down, then certainly most of the proppant would flow down.

But the proppant within that fracture, the concentration -- if we look at the -- If we take a fracture here, and we pick any point in the fracture -- let's say this is the coal. Most of our fractures down here, well, certainly, most of the proppant is going to be down here.

But if we look at any square foot of fractured area, which is what is important here, the amount of proppant -- it will be the same, in any square foot. That's what really controls flow, not where the proppant went. I mean, there's proppant in nonproductive intervals. That's not doing us any good.

Q. Now, does FRACPRO give you a width distribution for the treatment simulations?

A. Actually, I don't know that it prints it out. It does have the width distribution. It only gives you the maximum width at the wellbore, that printout, though.

Q. I see. Well, in the case of the simulations here where you have four fractures in the coal, does the simulator presume that the fracture widths for each of the four fractures are the same?

A. Yes, it does.

Q. In the case of the fracture originating in the Pictured Cliffs formation, we have single fracture, right?

A. That's correct.

Q. And generally, the fracture-stimulations in the coal were, as you said, three to four times the size of the frac jobs on the Pictured Cliffs? Do you agree?

A. I agree.

Q. Wouldn't it make sense, then, that the size of the four fractures you've modeled for the coal would be about the same fracture area as the single fracture in the Pictured Cliffs formation? Does that make sense to say?

A. I would not make that statement, no.

Q. Well, if the fracture-stimulation treatments in the coal, four times the size, and you have four fractures, and if the simulator presumes that the four fractures are basically equal width, those ought to add up to the same fracture area as the single fracture in the Pictured Cliffs, of smaller size?

A. No.

Q. You don't agree?

A. No, because you're initiating a fracture in a different formation. The stress in that formation is different, and the width -- even though FRACPRO calculates equal width in those four fractures, the sum of those widths may not be qual to the sum of the single width of a single fracture.

Q. With respect to the fractures in the coal that you've modeled anyway, I think if you look at your Exhibit BR-14 --

A. Okay.

Q. -- it looks like that depicts fracture widths of basically equal width in the coal, right?

A. Yes.

Q. Okay.

A. But that's not meant to represent a model study or anything; it's just an artist's conception of what goes on in the ground.

Q. All right.

A. I apologize for those being approximately the same width.

Q. Okay, which -- Is a -- generally, a wider fracture capable of holding more or less proppant than a smaller-width fracture?

A. Depends on how tall and long the fracture is.

Q. All right. And at the same time, is a wider fracture going to be more prone to dropping out proppant than a smaller-width fracture?

A. If you're looking at pure settling, I would agree with that statement. But there's another mechanism that some people have claimed is involved in these processes, and in that case, the more narrow-fracture fluid tends to restrict the settling or downward proppant movement. So I have to qualify my answer.

Q. Let me ask you about tracer surveys. You briefly discussed those last night, and I believe you made the point that you don't put much stock in tracer surveys; is that fair to say?

A. I have a lot of faith in tracer surveys.

Q. But you didn't use them in conjunction with this study?

A. I did not have any tracer surveys in conjunction with my study.

Q. Why didn't you use them in this case?

A. I did not have any tracer surveys for my study.

Q. Well, I understand, but they're available to you, aren't they? Go out and get the --

A. No, they were not, not when I was performing my study.

Q. You heard testimony by Mr. Nicol and Dr. Conway about their first-hand observations and experience when fractures stopped growing when they encountered sand shales and sand coals. Do you recall them discussing that generally?

A. I remember Dr. Conway's simulation that showed the fracture to stop at the base of the coal, if that's what you're referring to.

Q. Let's look at Exhibit N-31 in Mr. Nicol's exhibit notebook. That would be our Notebook 2.

MR. NICOL: Scott, there's a big one on the board --

MR. HALL: All right.

MR. NICOL: -- way in the back.

Q. (By Mr. Hall) Now, this is a log showing a PC sand and a Fruitland Coal, right?

A. No.

Q. Yeah, not -- It's Mesaverde, not PC, I stand corrected.

And can you tell us which zone the well is perforated in?

MR. GALLEGOS: Just -- If we could, Mr. Hall, can we have a little more idea? This is not San Juan Basin, correct? This was Mr. Nicol's --

MR. HALL: That's correct.

MR. GALLEGOS: -- example of --

MR. HALL: This is an example from a well in Garfield County, Colorado.

MR. GALLEGOS: The Mesaverde.

THE WITNESS: Unless I'm missing it, I don't see anywhere on here where it says where it says the perforations are. If Mr. Nicol or someone can show them to me, that would be fine.

Q. (By Mr. Hall) They're hard to see, but I believe if you look at these marks in the gray columns --

A. That single point is the perforations?

Q. Right.

A. There's only one hole there?

Q. Presume that there are four shots of perforations at each of those marks.

A. Spread out over what distance?

MR. NICOL: One foot.

THE WITNESS: One foot?

Q. (By Mr. Hall) They're one foot.

A. Okay.

Q. From this exhibit, can you show us where the fracture stopped growing?

A. Were all these individual fracture treatments on these zones? I presume --

Q. Yes, I believe so.

A. I don't know.

MR. NICOL: I think the bottom four sets of perfs were frac'd as one job.

THE WITNESS: Okay. So the FRACPRO pictures here represent individual fracture treatments that were pumped, or were they pumped all at once? I -- Are they individual fracture treatments?

MR. NICOL: Do you want me to testify on that exhibit? The FRACPRO program is a prediction --

THE WITNESS: Just tell me, that's all I want to know. I don't care if you testify, just tell me.

Q. (By Mr. Hall) Well, the FRACPRO was a prediction using this treatment as it was designed. And then the log shows the tracer survey results.

A. But I need to know how the treatments were pumped. Were they pumped as individual treatments, were they all fracture-treated together, all the different zones?

Q. Those intervals where it shows red and yellow --

A. Which red and yellow?

Q. Here down, is one treatment. Here the blue, this is a separate treatment. So that was one treatment. And this depth, these are perforations down here.

A. Okay.

Q. Separate treatment up here.

A. Okay.

Q. Do you see where the shales and coals are marked on there?

A. No, I do not. Okay, go ahead and ask your question. I'll try to answer it. I just --

Q. Well, the brown -- The tracer survey log shows the shales brown, and the coals are in blue. Do you see that?

A. I see blue and brown layers here, yes.

Q. Okay.

A. Not -- The tracer log doesn't give those, though.

Q. The correlations across there.

A. Okay, yes, I see them.

Q. Yeah. And doesn't this show that these fracture treatments stopped growing at those shales and coals?

A. No, it shows me there's gamma-ray activity in between the shales and the coals. I see one zone that's not even perforated that has gamma-ray activity within the shale or the coal, whatever that bluish-gray-brown layer represents there.

I see gamma-ray activity in several places where there aren't even any perforations, which tells me either there's gamma-ray material still inside the casing being detected by the spectro-scan log, or there's possibly a fracture outside that point in the formation.

But it does not tell me the fracture height. No, not at all.

Q. Let's talk about your analysis of the production data, Mr. Robinson. Page 8 of your testimony, about line 18, lines 18 and 19, you say generally there that each of the wells, just picking Chaco Pictured Cliffs wells, drains a fairly large area, as you say there, about one quarter of a section. So 160 acres, basically, right?

A. Between 100 and 150 acres, yes.

Q. Okay, yeah. In your Exhibit BR-20, as you say, you're showing a drainage for the Chaco 1 on BR-20 of 107 acres, right?

A. That's correct.

Q. And that's substantially smaller than 160 acres, would you agree?

A. It's approximately two-thirds of 160 acres, so I would agree that it is smaller.

Q. Why aren't these wells draining -- Why are they only draining, as you say, these smaller areas, 107 acres, and not the quarter section as you said earlier?

A. Mainly because of the well spacing that exists in the area. There were wells drilled very close to these wells that I showed on my Exhibit -19 (d), I believe, most of which are plugged and abandoned now, by the operators. So that's probably my primary reason, because of the development of the area.

Q. Tell me what well drained the Chaco 5.

A. What well -- I have no idea.

Q. Was it competing with another well?

A. I would say there's one, two, three, four, five, six, seven, possibly eight wells drilled within a mile of the Chaco 5, draining the Pictured Cliffs, that potentially could be competing with that well.

Q. But you can't tell us which one or how much production that other competing well made?

A. Of course not.

Q. And likewise, you didn't map any barriers for the Chaco 5, for instance, did you?

A. I'm not a geologist, I did not map anything.

Q. Okay. You don't see any evidence for barriers?

A. I see a lot of evidence for pressure interference. Now, are you talking about barriers as in geologic-type permeability barriers, or are you talking about interference?

Q. Interference barriers.

A. I see a lot of evidence for interference, clear --

Q. How about geologic barriers?

A. I'm not a geologist. I can't testify to the geology in this area.

Q. So you don't know if any geologic barriers exist?

A. No, I do not.

Q. You said the pressure in the Pendragon wells prior to stimulation was about 80 to 100 p.s.i.; is that what you said last night?

A. Yes.

Q. You didn't present any evidence for that, did you?

A. I did not. There has been other evidence presented, though, that I've reviewed, by Whiting and Maralex, pressure measurements that I used to form that opinion.

Q. I see. So you relied on Maralex information?

A. Yes.

Q. Let's look at your Exhibits -19 (a) through -19 (d), your average monthly rate exhibits. You, just before the hearing, substituted these exhibits, I believe. Why were the earlier versions wrong?

A. The technician who was making these plots for me, he downloaded these data from our database into a spreadsheet and he sorted the columns, and what he did, he forgot to sort one of the columns that was tied to well location. So all the numbers got mixed up in the spreadsheet, and so all the dots were in the wrong place. The dots were correct, they were just on the wrong spot on the map. So he went back and re-sorted the data. I caught it, with the help of Mr. O'Hare, and so he went back and re-sorted the data and reprinted the graph.

Q. But even though those were in error, your conclusions didn't change, did they?

A. Didn't affect my conclusion one bit.

Q. I see. In the case of -19 (a), you say average monthly rates. Why do you say an average over that period of time, five years? Why did you pick that time interval?

A. I tried to pick -- A lot of these wells have produced 20 years, some 25, some 15. You know, they've been producing a long time. And I wanted to show sort of a history of the production of these wells as a function of time, and I could have picked six months and had 50 graphs in here representing the 20-year histories of these wells.

I just tried to pick a convenient time period where I could put in four or five graphs or illustrations to show the production history of these wells. It was arbitrary, absolutely no reason other than convenience to pick that time frame.

Q. Now, did you use six-month averages over five years like Mr. Brown had done? Are these daily averages or what?

A. No, these -- What we did is, we took -- You get monthly production from *Dwight's*. And we took the cumulative production for the first five years and divided it by five. Actually, you divide it by 60 because there's 60 months. And you get the average production for that five-year period. And we made a bubble on the map. Then we took the production for the next five years, divided by 60, put a bubble there. So with time, that bubble should get smaller.

Now, I could look at 20 of these graphs and there would be more resolution in the size of the bubbles, obviously. But, you know, we chose five years and we just took the cumulative production, divided it by the number of months and said that's the average monthly rate.

Q. Okay, so -- Yeah, this is a rate. But you included, for instance, down days over the period?

A. No, we did not.

Q. I see. Would the exhibit show which of the wells might have been logged off or loaded up with water? Do you account for that?

A. It might, if -- The black dots are PC wells that quit producing during that time period. Let's look at -19 (b), would be a good example. You see a lot of black dots there on -19 (b) that are green dots on -19 (a). Green means the well produced for the entire five-year period.

Now, if that well quits producing at some point during that next five years but it wasn't plugged, then it got a black dot. If it was plugged, then it got the plug-and-abandonment symbol. So it could have been loaded up with water, you know, whatever -- temporarily abandoned. Whatever reason, it stopped producing for some reason during that time period. I don't know what the reason was, but -- So it could reflect your load-up problem.

Q. It could easily reflect wells that were producing because of formation damage, then, too, right?

A. Yes.

Q. Which of your Exhibits -19 (a) through (d) --

A. Well, I'm sorry, I take that back. you said it could easily represent wells producing with formation damage, and no, it would not represent that --

Q. What I meant --

A. -- because these wells would have to stop producing to get the black dot.

Q. All right. What I meant to say was, it would have included wells that weren't producing because of formation damage, right?

A. Well, sure, I guess.

Q. All right. Which of your Exhibits -19 (a) through (d) would show conditions in 1995?

A. Which wells show conditions in 1995?

Q. Well, which of your exhibits?

A. Which exhibit, okay, I'm sorry. Probably -19 (d) comes the closest to representing conditions in 1995.

But, you know, this is a zero-time illustration. In other words, all wells start at zero time. So the actual dates don't factor into this, but -- because most of these wells were drilled in the late 1970s. And so -19 (d) represents a 16- to 20-year producing life. And -19 (d) probably comes closest to representing what existed in 1995.

Q. You don't show total field gas in place anywhere for the Pictured Cliffs, do you?

A. On -19 (d)?

Q. Anywhere?

A. No.

Q. So you can't show what percentage of original gas in place at any of the wells on any of the Exhibit -19's would have produced from the Pictured Cliffs?

A. Not with the exhibits I have, no.

Q. Let's look at Exhibit -19 (a). You show the Chaco 1-J and the 2-J up there in Section 1. Do you see those there?

A. Yes.

Q. And I think we're all in agreement now that those wells aren't communicating with the coal, correct? We agree on that at this point?

A. No, I would not agree with that.

Q. Well, you said -- I think we're in agreement that those wells are not producing from the coal; do you agree with that much?

A. I would agree because the wells are shut in.

Q. Well, prior to the shut-in, were they producing from the coal, would you agree with that?

A. I wouldn't agree to that, no.

Q. Okay. Well, in any event you're showing that those two wells are pressure-depleted on Exhibits -19 (a)?

A. No, this doesn't represent that they're pressure-depleted, -19 (a).

Q. What does it show?

A. -19 (a) shows -- The green dots are all Pictured Cliffs wells that produced during -- the average production for the first five years. The size of that bubble represents the flow rate during that time.

The black dots are wells that did not produce a full five years. They are shown on the records as being Pictured Cliffs wells, but they did not produce the full five years.

The red dots are simply a designation of Pendragon, quote, Pictured Cliffs wells.

Q. And nothing more?

A. And nothing more.

Q. I see. Let's look at your Exhibit BR-24.

A. Okay.

Q. It's your comparison of the Chaco wells to a number of other Pictured Cliffs wells. I believe it says all PC wells. How many additional wells were included on that green plot there?

A. It was about 135 wells.

Q. All right. I won't ask you to identify each and every one, but what area did you select those PC wells from?

A. That was the 20-some-odd sections immediately surrounding the subject area.

Q. Do you know if any of those wells included Fruitland sand wells?

A. I do not know. The average plot shown there is based on their official designation at the Commission.

Q. All right. And as I understand your display here when it shows the plot for the Pendragon Chaco wells, it looks to me that they were substantially underperforming when compared to all of the other Pictured Cliffs wells; is that what it shows?

A. I would draw that conclusion, yes, up until the time of the fracture treatments, of course.

Q. Page 11 of your testimony, you say, about lines 8 through 11, you say generally that the decline on the Chaco wells was due to poor reservoir quality or smaller drainage areas.

A. I'm sorry, what -- Page 11 --

Q. Page 11, lines 8 through 11, your explanation for the decline for the Pictured Cliffs wells is, one, either poor reservoir quality or, two, smaller drainage areas.

A. Yes.

Q. But you've already said that you think that the reservoir has pretty good permeability, on the order of about 100 millidarcies, generally?

A. No, not at all.

Q. You don't think the reservoir has good perm?

A. I didn't say that. I agree that it has permeability. I don't agree that it has 100 millidarcies.

Q. Okay. Do you agree that it has good permeability?

A. I believe I stated last night that this is one of the more permeable Pictured Cliffs areas that I've seen, 25 to 30 millidarcies.

Q. Well, I guess I'm not sure what you're saying as to the explanation for the production decline. Is it a smaller drainage area or poor reservoir quality? If you say it has good perm, it can't be poor reservoir quality, can it?

A. No.

Q. So which is it?

A. Got to be small drainage areas.

CHAIRMAN WROTENBERY: Time for a break.

MR. HALL: Take a break?

CHAIRMAN WROTENBERY: We're ready for one.

MR. HALL: Sure.

CHAIRMAN WROTENBERY: Okay, we'll take a break till 10:30.

(Thereupon, a recess was taken at 10:15 a.m.)

(The following proceedings had at 10:30 a.m.)

CHAIRMAN WROTENBERY: Okay, are we all back here?

MR. HALL: Ready?

CHAIRMAN WROTENBERY: Yes, let's go ahead.

Q. (By Mr. Hall) Let's refer briefly again back to your Exhibit BR-25 -- I'm sorry, -24. Let's look at the non-Chaco PC wells on your green plot. For year 18, what explains the production incline there?

A. I don't know.

Q. Is it possible that other operators are getting additional production by frac'ing the PC these days?

A. It's possible. It's also possible that a lot of the PC wells, noneconomic wells that went into the average, were plugged and abandoned. Therefore, the average production from a PC well increased at that point.

Q. I see.

A. It could be due to acid treatments, could be due to several different things.

Q. I see. I want to ask you about some of the comments you made with respect to Mr. Cox's analysis. I believe you said that Mr. Cox described the coal as having open fractures on the order of .1 to .25 inches thick; is that what you said this morning?

A. That's what I understood him, Mr. Cox, to say.

Q. Have you ever observed cleats of this width in the coals?

A. Yes.

Q. And what's the permeability of an open fracture, say a quarter of an inch wide?

A. I don't know.

Q. Huge, wouldn't it?

A. It would be a fairly large number.

Q. Do you think the coals here have that high a permeability, a permeability equal to what you'd see in a fracture a quarter of an inch wide?

A. Well, you've got to remember, we're measuring the permeability of these coals. We're not measuring the permeability of that crack over a one-inch distance, we're measuring average permeability over a fairly large area. We injected gas into the Whiting Federal 1-1 well for about 36 hours. That gas is going to penetrate possibly hundreds of feet into the formation. So what we're measuring there is the average permeability of the entire cleat system, and there's going to be small fractures, there's going to be joints, you've got fractures that are 90 degrees from each other.

So there's going to be things that would make the overall average permeability less than if you took and measured the permeability of a half-inch-wide crack. Sure, the permeability of that crack is going to be darcies, extremely high permeability. But you've got to take it in the right context. You can't pick an inch of rock and try to represent that as the reservoir, it just doesn't fit.

Q. Isn't the correct way to describe the width of a cleat opening, is to say cleat arperture?

A. It's "aperture".

Q. Aperture, thank you.

A. Yes.

Q. And on the other hand, cleat spacing is the distance between widths?

A. That's correct.

Q. And what Mr. Cox was talking about in his testimony was cleat spacing, not aperture?

A. So I was wrong?

Q. That's what I'm suggesting. Do you agree?

A. I heard Mr. Cox say the average width of these cleats was a tenth to a quarter of an inch. If I misunderstood, I stand corrected.

Q. All right. Did you do a PROMAT analysis of the coalbed methane wells here?

A. No, I did not.

Q. Holditch has a commercially available coalbed methane simulator, doesn't it?

A. Yes, it does.

Q. You didn't use it in this case?

A. I didn't present those results, but we did make calculations with the coalbed methane simulator.

Q. You have discussed some of the tests that could be run to evaluate formation damage. Why don't you repeat those for us briefly?

A. You have different types of pressure-transient tests. Most popular, certainly the most common, is what we call a pressure-buildup test. You've got pressure-drawdown test, you've got injection tests.

In the case of the Gallegos Federal 1-1 well, we ran what you call an injection falloff test where we injected gas and measured the pressure during the gas injection and after we quit injecting.

You can analyze production data on actual wells with different type curves. Fetkovitch published production type curves many years ago that have been used in our industry for a long time.

We have built a program called PROMAT that will analyze production data. It basically uses the transient and steady-state flow equations and analyzes production data in order to get an estimate for permeability and skin factor.

So those are probably the major ones.

Q. So there are tests you can do in the field and there are tests you can do at the lab, both?

A. Oh, certainly, yes, and the lab too, cores and so forth.

Q. And there are lab tests that would allow you to evaluate the possibility of fines migration in the formation?

A. Yes, there are.

Q. And those -- what? -- require a core for you to do that?

A. That's right, a core.

Q. There wasn't any core available in this case, was there?

A. There was a core on the Lansdale Federal, but I have no idea where that is. I wished I had it.

Q. If you did all the tests conceivable to do a really comprehensive evaluation for reservoir damage, it would cost a pretty penny, would it not?

A. No, not at all, there's some very inexpensive analysis methods, as I mentioned, a Fetkovitch type curve. You could probably hire me for $500 to do a PROMAT analysis on production data, and I can give you a relatively good idea of what the amount of skin damage, permeability and so forth. I mean, there are tests, you don't even have to shut in your well. You can do a multi-rate test where you just change the flow rate a few times, and all you do is monitor the pressure. We can calculate skin factor very easily from that. It doesn't cost a lot at all.

Q. Yeah, well, how do you do a flow-rate test when the well can't even produce?

A. Well, obviously it would be very difficult.

Q. You mentioned compaction as a possible explanation for damage here earlier today, right?

A. That's one possible mechanism that can exist. Now, whether it exists in this area or not, I don't know.

Q. Yeah. Mr. McCartney didn't say compaction was a likely cause, did he?

A. No, he did not. And he couldn't, because he said there wasn't substantial depletion. So he couldn't -- The compaction theory wouldn't fit.

Q. All right. Little bit more about your PROMAT analysis. You have that summarized in your BR-15 exhibit. Now, your volumetrics for the Chaco wells, as they're set out in your PROMAT analysis, depend directly on reservoir thickness and drainage area, right?

A. No.

Q. Well, you wouldn't take thickness into consideration?

A. Of course I would.

Q. And what thicknesses did you take into consideration here for the 2-R, Chaco 2-R?

A. Chaco 2-R? All of the reservoir properties that I used in the PROMAT analysis, again, are depicted on Exhibits BR-20, -21, -22 and -23. Those are the net pays.

The porosity saturation that we used in the PROMAT model to calculate the drainage area, I didn't assume anything, didn't assume drainage area. That's why I answered no to Mr. Hall's question a minute ago. I didn't assume that. That was calculated based on transient flow equations and steady-state flow equations in the PROMAT model.

Q. Well, I've handed you what we've marked as Pendragon Exhibit Robinson-2, and it's the log for the Chaco 2-R. Can you count off the net-pay thickness off that log for us, please?

A. No, I cannot.

Q. Why can't you do that?

A. Because I would have to have a porosity log in order to -- and a gamma-ray, in order to estimate the amount of net pay from this log.

Q. So you didn't have any other logs available to you?

A. No, I did not.

Q. But you picked 9 feet pay thickness for this well. How did you determine that?

A. That was estimated based on porosity logs from offset wells.

Q. I see.

A. And correlation, I believe, with Mr. Ayers of the thickness of the sand going towards the Chaco 2-R.

Q. All right. If you look on Exhibit Robinson-2, which nine feet would be shown on this log, can you identify that for us?

A. No, I'm sorry, I can't.

Q. You had discussed the pressure response that was included in Mr. Cox's evaluation of the wells here, and you had some disagreement with his use of pressure response time; is that what you said this morning?

A. I didn't say I disagreed with it, I said I have never heard that definition. And what I disagreed with was that the transient response time is a function of net pay and will decrease with a higher permeability. That's 180 degrees opposite from pressure-transient theory. That's what I disagreed with.

Q. So instead of using the phrase "pressure response time", you call it "transient response time"?

A. That's what everybody else calls it.

Q. I hand you what we've marked as Pendragon Exhibit Robinson-C. These are from the materials you provided us last night, from your injection falloff test.

By the way, you agree this is a falloff test and not a slug test, right?

A. It's an injection falloff test.

Q. What's the difference between the two?

A. Well, there's different ways to run a slug test, so you know, most of the time you just -- The most economical way is to dump some water in the coalbed methane and measure the change in fluid level, basically, on the -- just to measure the change in fluid level. That tells you how much injection is going in over what pressure range.

So this is a more sophisticated test than what people normally run a slug test, you know, where we actually injected the gas into the formation, measured the pressure response as a function of that gas injection, and we stopped the gas injection and measured the pressure response after we stopped.

CHAIRMAN WROTENBERY: Mr. Hall, just for clarification, yesterday we talked about two injection falloff tests.

MR. HALL: Yes, and I understood --

CHAIRMAN WROTENBERY: What is --

MR. HALL: -- the data was available only from one; isn't that correct?

THE WITNESS: This is the second one. The first one was not valid, they had some leaks at the surface and they closed some wrong valves when they shouldn't have. So we invalidated or, you know, threw out the first test as invalid and re-ran the whole test and did it correct this time.

CHAIRMAN WROTENBERY: This is the second test?

THE WITNESS: This is the second test, yes.

CHAIRMAN WROTENBERY: Thank you.

Q. (By Mr. Hall) So for the record, let's just establish that what's been marked as Exhibit Robinson-C is the data derived from the second injection falloff test?

A. That's correct.

Q. All right. And this is the test that you designed and asked Maralex to run?

A. That's correct.

Q. And did you indicate Maralex resisted the test for some reason?

A. Well, no, I'm sorry, I was joking. You know, I tend to ramble like that from time to time --

Q. Okay.

A. -- just to try and lighten things up. They did not resist at all. We discussed the design of the test, we discussed, you know, what's going to happen if we prove Mr. Cox's theory that the 20 millidarcies is correct. We decided that it doesn't matter, we want to know what the permeability of the coal is, that's the real issue here, so we are going to do this test.

So you know, I apologize for making the comment.

Q. That's all right.

A. It was a silly joke on my part.

Q. I understand.

Were you out in the field when the test was run?

A. No, I wasn't.

Q. Okay. Can you describe for us the set-up for the test?

A. No, I cannot, I'm sorry.

Q. Well, wouldn't you have to know the plumbing array and where the meters were set and the compressors and all? Did you have any input on that?

A. No, I did not, and it's not necessary to analyze the test. I know how they did it generally, but I don't know the plumbing or anything like that.

Q. All right. And if I recall, you said you analyzed the test yourself and also had some of your colleagues at Holditch look at the test as well. And the analyses here, you show in Exhibit -C, were prepared for you by the other members of Holditch, or did you prepare these?

A. I prepared these.

Q. Okay. Now, it appears that there are four different analyses here; is that right?

A. Probably, yes.

Q. The analysis on the top says "Superposition type curve", and it's labeled "Radial flow, Single porosity, Infinite-acting". What does that mean? Explain that to us.

A. This is just the most basic of type curves, where we have a simple radial model. It's only a single-porosity system. It is infinite-acting. And so this would be where you start. Anytime you're analyzing a test like this, you start with the most simplest model you have. And then, with justification, you go to more complex models.

Q. And by the way, which well was this done on, so we'll recall?

A. This was the Gallegos Federal 26-13 1-1 well.

Q. All right.

A. If I'm reading my map correctly.

Q. Now, the analysis on top doesn't take into account that the well was hydraulically fractured, does it?

A. Yes, by virtue of the fact there's a negative skin there, that says that that formation is stimulated.

Q. That's the conclusion you draw from the results, but the program itself doesn't have any particular component to recognize hydraulic fracturing, does it?

A. No, there -- What it uses in the equations for the calculation is what we call an effective wellbore radius, which all that is, is -- makes the well real big, to account for the fact there's a fracture there. The area of that effective wellbore radius is essentially -- would be equal to the area of the fracture.

But no, the fracture length does not go into the equation for the radial-flow model.

Q. Okay.

A. Only effective wellbore radius.

Q. Got you. Let's look at the second page of Exhibit Robinson-C. It says "Summary" page there at the top. And then there's a heading, "Description", various categories there, you see "Reservoir type". What reservoir type does it say in this case?

A. "Conventional".

Q. Well, what does that mean?

A. That means it's a single-porosity system, conventional gas, reservoir matrix flow, you know, good old sedimentary-type reservoir.

Q. So this analysis didn't recognize the fact that we were dealing with a coalbed methane reservoir in this case?

A. No, it did not.

Q. Now, let's look at the section on that same page, it's -- the heading is "Wellbore Data".

A. Okay.

Q. Under "Packer type" -- Do you see that there?
A. Yes.
Q. -- it says "Complete seal". What does that mean?
A. It means that if there was a packer in the well it would be completely sealed and shut off the annular space in the wellbore.
Q. I see. And this particular well was on pump before the test was run, right?
A. That's correct.
Q. So it wouldn't have had a packer in it while it was on pump, correct?
A. That's correct.
Q. So in order to run the tests, you had to pull the rods and the pump and the tubing, rerun the tubing and set a packer on the bottom; is that what was required?
A. That was the original plan. And I'll tell you right now, that's wrong, in the program. We assumed -- The original plan was to pull the rods and pump, run the tubing with a packer to shut off as much of the wellbore volume as possible. Due to time constraints and operations, field operations, they did not do that. The engineer, up there under "Analyst mdz", that input this data for me, had understood that that's what they were going to do. He selected that option in the program, and it's wrong.
It doesn't affect the analysis, because I've

already checked it, but I didn't try -- And I've already sent you two corrected exhibits; I didn't feel like making a third one.

Q. How long did you have to shut in the well before you began injecting?

A. How long did we have to?

Q. Well, how long did you?

A. The well was shut in, probably about -- I don't remember, maybe about 12 to 24 hours, something like that, while they -- you know, they pull the rods and pump and run the gauge and all that kind of stuff. So I'm guessing it was 12 to 24 hours.

Q. Well, after this well is shut in, how long does it take for it to build back up? It would be --

A. I don't recall.

Q. -- several days, wouldn't it? Wouldn't you agree it would be several days?

A. To build up to what?

Q. Pre-shut-in pressures.

A. To pre-shut-in pressures?

Q. To an average reservoir pressure.

A. To an average reservoir pressure, it probably would take several days.

Q. Okay. What was the producing rate immediately before the shut-in?

A. Off the top of my head, I think it was around 500 or 600 MCF per day.

Q. Let's look at the third page of the Exhibit Robinson-C. If you look at the section with the heading "Fluid Properties at Reference Pressure" and then you see a category there, "Initial total compressibility", what is that value?

A. .0104893.

Q. Okay, so .01 p.s.i. then? That's the reciprocal p.s.i., right?

A. Yes.

Q. And is that a high compressibility consistent with a coalbed methane well?

A. I would say -- High compressibility? I mean -- To answer your question, that's probably not -- Well, I don't know.

Q. Okay. Let's look at the next heading there. It says "Time zero". It says "Pressure at time zero". What's the value reflected there?

A. 94.75 p.s.i.

Q. Now, keep your finger on that and look at what's been marked as Exhibit Robinson-B. Recognize these in order, that's why we marked them last night.

Can you identify Exhibit -B for us?

A. It appears to be a copy of the data recorded during the injection falloff test.

Q. Okay. And by the way, it says "Slug Test " at the top. Does that make any difference?

A. No.

Q. Okay.

A. It makes no difference.

Q. Yeah, and this is the data you got from Maralex, then, right?

A. That's correct, that's what it appears to be.

Q. And if you go at the top line on the table there, it shows in the first line, it shows an elapsed time of 12 hours, and it looks like you injected 760 MCF per day; is that right? That was your injection rate?

A. Yes.

Q. In your analyses, have you -- Do you have analyses of the pressure behavior of this first injection period and the final falloff?

A. Yes, we do.

Q. Okay, let's turn to the third page of Exhibit -B, Robinson-B. Do you see where it indicates "Begin Injection Test" down there near the bottom?

A. Yes.

Q. And then the pressure, the next line -- Well, the pressure shown at the commencement of the injection test, what does it say there? 70.15 p.s.i.g., is that right?

A. Yes.
Q. Then just below that, after injection began, what does it show there for pressure?
A. 98.22.
Q. Okay. And what do you see for a pressure in the line immediately following that?
A. 98.75.
Q. And those are gauge pressures, right? They're not p.s.i. absolute, are they?
A. That's correct.
Q. Let's go back to Robinson-C again, and we had -- we kept our finger on the third page of that, and we had to establish that the pressure at time zero, as reflected on that exhibit was 94.75 p.s.i. Do you see that there?
A. Yes.
Q. So that's not right, is it?
A. No, that's correct.
Q. Well, it doesn't compare with what's shown on Exhibit Robinson-B where it shows the 70.15 pressure. They're in disagreement, aren't they?
A. That's a different number, right.
Q. Go ahead and explain, if you want to.
A. Yeah, what you do there is, you make a -- It's a zero-time correction. You know, you do that on any pressure-transient analysis where it's not real clear from

the data the exact point in time where the pressure started to increase, what that zero-time pressure is.

And in this particular case there was probably water in the well, and we had to displace that water before we got gas into the formation. So there's going to be a huge pressure increase that's been displacing that water in. And when we get that gas in there, then you're going to start measuring the true zero-time pressure for the gas. And that's what we've done here, we made a correction for that.

Q. Okay. A pressure bomb was on the bottom of the well, right?

A. That's right.

Q. Again, back on Exhibit -C where we have that 94.75 p.s.i., the value right under that is adjusted pressure at time zero there, and then it shows a value of 64.1 p.s.i. What does that pressure tell us? What does that mean?

A. Adjusted pressure is a -- With gas reservoirs, you can't use pressures. I mean, you can do pressure squared over a specific pressure range, but still that's not very accurate.

So what we've developed is what is called pseudo-pressures. It takes into account the compressibility of the gas and the fact that the viscosity changes as a function of pressure. And those units are like p.s.i.-centipoise per something. You know, it's just units nobody recognizes.

So we take that pseudo-pressure and multiply it times the average compressibility and average viscosity to get the thing back to units of p.s.i., a unit that most people can at least recognize. So what that is, is the pseudo-pressure equivalent for gas reservoirs in a term we call adjusted pressure.

Q. All right. Let's look at the next heading on that same page of Exhibit -C. The heading is "Pressure Corrections", do you see that there? And you have the categories "Corrected pressure at time zero", and then it looks like the next one is "Corrected adjusted pressure at time zero".

A. I'm sorry, what page were you on?

Q. It's the same page, it's page 3 of Exhibit Robinson-C.

A. Okay, I'm with you.

Q. Do you have that there?

A. Yes.

Q. Yeah, I was referring to the heading "Pressure Corrections".

A. Uh-huh.

Q. You see the two categories, you have "Corrected pressure at time zero" --

A. Yes.

Q. -- then "Corrected adjusted pressure at time zero", just below that.,

A. Yes.

Q. What do those values signify?

A. The corrected pressure at time zero is simply the pressure less atmospheric pressure, which we assume to be 14.7 p.s.i. And again the corrected adjusted pressure is just the pseud-pressure equivalent of the actual measured pressure.

Q. Well, is the 14.7 p.s.i. the correct pressure to use at these altitudes, these elevations out in the San Juan Basin?

A. It could be, you know, one p.s.i. less at the higher altitude. Being from Texas I use 14.65, and so I'll admit I should have probably used a p.s.i. less. It's not going to affect the analysis. I mean, if we're going to nit-pick this thing, let's please hurry.

Q. Okay, well, is that due to being from Texas like I am, or being from A&M? I'm just kidding.

A. Well, being from A&M, it took me a long time to even know what that meant.

Q. I know what you mean.

Let's look at -- turn to the page in Exhibit -C, it's about four more pages down, is "Plotting Functions".

A. Yes.

Q. Do you have that in front of you there?

A. Yes.

Q. There's a column that shows "Adjusted Pressures", and then right next to it there's one that says "Pressure Plotting Function". And so the pressure plotting function column, that shows the adjusted corrected pressure that was used in the analysis; would that be right?

A. That's what's -- the column to the left of the pressure plotting function.

Q. Now, does your analysis show anywhere were you use the actual measured pressure just before the injection began, that pressure being the 70.15 p.s.i. we talked about?

A. It's not reflected in these exhibits. The correction for zero time is available in the analysis. I didn't print out a zero-time correction plot, I apologize. I'll be glad to print that out for you if you need it.

Q. Well, the 70.15 is shown on the Exhibit Robinson-B, which is the data from the field. It just didn't make its way into Exhibit -C then; is that right?

A. It did not make its way into Exhibit -C, and I apologize.

Q. Okay. If you'd use the actual measured pressure just before the test began, the pressure difference for this point would have been -- for the first point here on your plotting functions tabulation, the measured pressure where it shows the 98.75, the difference would have been 98.75 minus the 70.15 pressure observed in the field, right?

A. Yeah, approximately 28 p.s.i.

Q. Okay. And the pressure change in a test like this is inversely proportional to permeability, isn't it?

A. And skin factor.

Q. And -- What's that?

A. And skin factor.

Q. All right. Let's back up to the third page of the exhibit where we were before in Exhibit -C and talking about where it shows -- First heading is "Water Properties" there.

CHAIRMAN WROTENBERY: Do you have a calculator Commissioner Lee could borrow with an exponential function on it?

MR. COX: (provides one)

COMMISSIONER LEE: Thank you.

CHAIRMAN WROTENBERY: Thank you.

Q. (By Mr. Hall) There's a heading down there, it says "Model Parameters", and it shows the final value for permeability was 268.6 millidarcies, right?

A. Correct.

Q. So that was the value of perm you calculated from your match from this type of well and reservoir?

A. That's correct.

Q. All right. Let's look about seven pages further into Exhibit -C where you have your superposition type curve for radial flow, transient dual porosity. Do you have that in front of you there?

A. Yes.

Q. Once again, here you've made a calculation based on radial flow. And again, as before, it ignores the fact that there was a hydraulic fracture treatment on this well; would that be right?

A. Yes.

Q. Dual porosity, as it's shown here, means that you considered the effect of natural fractures or coal cleats in the analysis, yes?

A. That's correct.

Q. Let's look at the next page of Exhibit C. There's a heading there that says "Description". Do you have that heading?

A. Yes, I'm there.

Q. Then there's some categories. If you go down the list there you go to "Reservoir type", and what reservoir type did this analysis assume?

A. A naturally fractured shale.

Q. And what does that mean to you?

A. The reason we chose the naturally fractured shale is because through our project at the Gas Research Institute in Devonian shales and just overall study of naturally fractured shales, we implemented a desorption factor into our shales model, because we found that in some shale formations you can't have gas actually desorbed.

So in an effort to try and get it as realistic as possible, a fractured system, which is the dual porosity, plus adding desorption and adsorption to it, we chose to make one analysis with this dual-porosity shale model.

Q. Let's look at the next page here. There's some headings, and let's look at the heading where it says "Isotherm Properties". Do you see that there? And you show "Langmuir volume", and the Langmuir volume reflect there is 697 standard cubic feet per ton, right?

A. That's correct.

Q. And if you'll recall, Mr. Cox testified that actual measurements of gas adsorption on coal samples in the area showed a Langmuir volume of about 166 standard cubic feet per ton. Do you remember him saying that?

A. That it was measured --

Q. Yes.

A. -- or that he calculated it?

Q. Actual measurements. His actual calculations from the core samples.

A. Okay, that's what I thought, not something you measure. Calculated. And, you know --

Q. From core samples, though.

A. From core samples, right. Yeah, I remember him saying that.

Q. Well, why don't you briefly define Langmuir volume for us?

A. I don't remember the equation for it. It's an equation that defines the amount of gas and pressure in a coal. There's a specific equation that is the definition of Langmuir volume, I just don't recall it off the top of my head, I'm sorry.

Q. Okay. What's the reason you used a value of 697 instead of 166 for the Langmuir volume here?

A. That was calculated by Michael Zuber, who's our coalbed methane expert in our Pittsburg office. I asked him to calculate those values for me so I could input them into this program.

Q. Okay, and he's not available for us to cross-examine here today, is he?

A. No.

Q. Okay, so we can't establish why those values were used of the 166?

A. I will call him at lunch or a break, and I can get you an answer to that question if you need it.

Q. Okay, I still won't be able to cross-examine him, is the problem.

A. We can hook him up on a conference call.

Q. Nah.

A. I'm sure he has an excellent reason for it.

Q. I'm sure he has better things to do on Saturday than this.

A. We all do.

(Laughter)

Q. (By Mr. Hall) Mr. Robinson, all things being equal, isn't the gas content of the coal directly proportional to the Langmuir volume?

A. Yes, I guess that's a fair statement.

Q. So if you're using a Langmuir volume that's about four times too high, you'll have a gas content for the coal that's four times overstated, right?

A. Technically, yes. But that doesn't affect this analysis. I mean, while we're talking about that. That analysis has nothing to do -- or that fact has nothing to do with the analysis of this test. If we're going to talk about gas in place in the coals or reserves or something like that, yeah, we can sit here and arm-wrestle over what the gas content is. That doesn't affect this analysis, though. The only thing that --

Q. Well, that's for the Commissioners to decide.

A. Okay.

Q. The next section, let's refer back to this page. We've just talked about the "Isotherm Properties" page in Exhibit -C.

A. Yes.

Q. I'm sorry these aren't numbered on the pages. In the next section below "Isotherm" under the "Fluid Properties" heading there, there's a category, "Initial total compressibility", and it shows about 3.24 per p.s.i. Do you see that there?

A. Yes.

Q. And the previous analysis at the beginning of Exhibit -C had a total compressibility of .01 per p.s.i. Do you recall that?

A. Yes.

Q. So changing this analysis here increased the computed compressibility by about 300 times, wouldn't that be right?

A. Yes.

Q. Now, you used a porosity of about .004 for this analysis, right?

A. That's correct.

Q. So what is your computed porosity-compressibility product? Work that for us?

A. Well, this is total compressibility. So if I calculate porosity times this number, that's not going to equal what Mr. Cox --

Q. Well, for this particular case let's calculate it. You have your .004 --

A. -- times 3.24, is .013.

Q. And that's about five to ten times higher than used by Mr. Cox, right?

A. Yes.

Q. Okay.

A. We're talking about different things here.

Q. Now, your model parameters for the second analysis in Exhibit -C shows a resulting permeability of 225.3 millidarcies. Do you see that? There's a heading down there, "Model parameters", and it shows a permeability category?

A. Yes.

Q. And it says "Final value, 225.3". And there are two more categories there, Lambda and Omega. And what is the Omega term?

A. Omega is the relationship between the gas in place in the matrix and the gas in the fractures.

Q. All right. So the gas value of Omega here being .5 means the analysis assumes that half of the gas in the reservoir contacted during the test is absorbed into the matrix, right?

A. No.

Q. Well, explain that.

A. .5 assumes that half of the gas in the system is in the matrix and half of the gas is in the fracture.

Q. Okay, in the cleats?

A. In the cleats, yeah.

Q. All right. Do you think that portrays reality?

A. In coal, that's probably a little low. It's probably closer to 1. Most of the gas that we inject is going to be in the natural fractures --

Q. Okay.

A. -- or cleats. But that .5 is a lot higher than a conventional fractured reservoir like a thinner shale, because you do have gas absorbed in the matrix of the shale.

Q. Now, let's -- staying on Exhibit -C, let's go down to your next analysis here. It's styled "Hydraulic fracture, Single porosity, Infinite-acting". Do you have that one in front of you?

A. Yes, sir.

Q. And does this analysis try to take into account the known presence of a hydraulic fracture?

A. Yes.

Q. Okay. On the next page, for the description "Reservoir type", under the "Description" heading there, category "Reservoir type", now it shows "coal", right?

A. That's correct.

Q. And then on the next page it shows "Isotherm Properties", and the isotherm properties you show here are the same that were used in the previous analysis? In other words, you have the 697-standard-cubic-foot-per-ton Langmuir volume again, right?

A. That's correct.

Q. And under "Model Parameters", that heading there, it shows for a final value for permeability, it shows 186.4 millidarcies in this case, right?

A. That's correct.

Q. And under that same heading it shows "Fracture half-length". It shows fracture half-length just over 60 feet and a conductivity of 7058 millidarcy-feet. Do you see those values there?

A. Yes.

Q. Can you explain the meaning of those two values?

A. The fracture half-length is the calculated effective half-length that exists in the coal. The fracture conductivity is the measure of -- with a single -- Let's assume we've got a single fracture. The conductivity would be the width of that fracture times the permeability of the fracture. And that's why it's in -- The width is in feet, and that's why the units are millidarcy feet, permeability times width.

In a coal seam where you might have multiple fractures, it's essentially the cumulative effect of the conductivity of those fractures in the coal. So it's the effective millidarcy-feet of width and permeability in the coal.

Q. So what do these results tell us here? You have a 60-foot fracture length and a conductivity of 7058. What do these results mean in this case?

A. That the well was hydraulically fractured.

Q. All right. If you assume permeability that's lower by a factor of 4, wouldn't that mean that the fracture length would be four times greater, then? Is that what this means?

A. If I assumed a permeability that was four times lower, the fracture length would be four times greater?

Q. If you force the match.

A. If you force the -- Well, that's a real key issue. You'd have to be able to match it with a permeability four times less and a fracture length four times more. And you wouldn't get a match, number one, so you can't make that assumption. I guess if you just look at the equation, yeah, it would be directly proportional --

Is that right, or is it the square of the root? I don't remember the equation, I'm going to have to go back and look.

If you assumed a lower permeability you would calculate a longer fracture length, sure, and it's just the way the equation works out. I'm not sure it's four, I'm going to have to check the equations.

But of course, you wouldn't get a match with the type curve over here. You can't -- The data would fall somewhere else on the type curve, so that's not a realistic assumption.

Q. We understand it to be a forced match.

A. I don't even think you would force it. Forced match means you can find a curve that matches the data.

Q. Right.

A. You know, if you can't find the curve that matches the data, you don't have a forced match.

Q. Okay. Let's look again at, under "Model Parameters" heading, the category "Choked fracture skin". What does that mean?

A. I'm sorry, what page are you on?

Q. It's the same page, under your third analysis.

A. Choked fracture skin is a reduced conductivity in the fracture near the wellbore.

Q. And then if we go back to your graph for your third case, is it -- just from the graphic portrayal, is it substantively different than the first or second ones? The first and second ones look pretty similar, right? And indeed the third one. They all look pretty much the same; would you agree?

A. I would say all three of them are pretty much the same, yes.

Q. Is that significant, that they all came out pretty much the same on the graphs?

A. It's the same data. I mean, the shape of the curves are going to be the same, regardless of what type curves you put the data on. The shape is going to be the same. You know, it's the actual data.

Q. Okay. Let's move on to your last analysis, your fourth analysis here, and the graph is "Hydraulic fracture, Single porosity, Infinite-acting", and this one is designated "FO". Do you see that there? What does that mean, "FO"? Does that mean falloff?

A. That means falloff, yes.

Q. And the ones before that were designated "INJ". Why were they designated "INJ"?

A. That represents an analysis of the injection part of the test.

"FO" designates an analysis of the falloff, after we've stopped injecting gas.

Q. All right. So this analysis assumes a hydraulic fracture is present in a single-porosity infinite-acting system, doesn't it?

A. Yes, coal, I believe.

Q. All right. This doesn't match too well with the graphs for the other cases, does it? It's not as good of a match as you got in the first three cases?

A. It's not as clean, no. It's a different set of data. As you can see, a lot of erratic behavior during pressure falloff, obviously the match is not as good.

Q. What is the odd-looking bump for the red plot right in the middle of the graph? What happened there?

A. I have no idea. I asked our Dr. John Lee, who's a world-renowned expert on pressure-transient analysis, used to work for our company, since retired, still a professor at Texas A&M, and also Dr. John Spivey, who's currently our expert on pressure-transient analysis, and neither one of them could come up with a reasonable explanation for this weird early time data. I mean, there's just something about the falloff data after injecting that gas that, in the coal, we just can't explain. I mean, coals are so complicated, I'm not surprised. But nobody that I asked had a reasonable explanation for that behavior.

Q. Okay.

A. And I asked a lot of people smarter than me.

Q. Two pages past the graph, are you with me?

A. Yes.

Q. More data, under the heading "Isotherm Properties". Again, we have the -- For the Langmuir volume we have the 697 standard cubic foot per ton. And then you go don below, the heading "Model Parameters" shows a category for the calculated permeability, and this is your 204.5-millidarcy perm, right?

A. That's correct.

Q. Then let's turn to the next page, let's see what this is. At the bottom it shows "Production Rates Prior to Test". What is that all about?

A. Well, as you remember, this is the falloff test after we injected gas. If you go over to the first page of Exhibit Robinson-B, the one that Mr. Hall -- there's a history of the gas injection. And then we stopped gas injection and monitored the pressure decline, and this is that gas-injection history.

Q. So these were the rates that you considered during the buildup period?

A. The falloff period.

Q. I'm sorry, falloff.

A. Yes.

Q. And this is a test you designed?

A. No, I didn't design it to look like that.

Q. Okay.

A. But I did recommend the 600 to 700 MCF a day, and they tried their very best to get that for me. Unfortunately, compressors sometimes don't cooperate very much.

Q. Would you have preferred a constant injection rate during the injection phase of the test? Would that have been more meaningful?

A. For an analysis of the falloff data?

Q. Yes.

A. Certainly.

Q. So having all of these rate changes, it makes it a little harder to interpret the data?

A. It doesn't make it harder to interpret, necessarily. You're very likely to get some unusual transient behavior can make it harder to interpret. You know, sometimes you get lucky and it doesn't have much effect on it. But occasionally, you know, sometimes -- The more the rate changes, obviously, the more complex the transient behavior. And yes, it does become more difficult to analyze.

Q. Well, do the rate changes make your test results less reliable?

A. No, not really, because we can account for rate changes using principle of superposition. You know, it's a common method accepted by the petroleum industry for a test on a well that has changing flow rate. So no, all those corrections for variable flow rates were taken into account in the superposition.

Q. You'll agree if there were errors in the times and the rates assumed, that would change the result, correct?

A. It wouldn't change the result. If there were errors in the data, it would certainly make the results less reliable. But I'd still get the same answer, I just wouldn't know --- It would be wrong and I wouldn't know it.

Q. Let's move back again quickly to your Exhibit Robinson-B.

A. Okay.

Q. And the third page on there, it shows when you began the injection test, and it shows the test was begun at what time? It looks like 9:15?

A. 1915.

Q. I'm sorry, 1915, or 7:15 in the afternoon. That's on July 12th, right?

A. Yes.

Q. So they started injecting at a high rate beginning at that time for 12 hours, and the well was basically shut in so the injection period would have been

right until about 7:15 the next morning?
A. Okay.
Q. And if you look two more pages down, and you can tell -- I'm referring to the Bates number at the bottom right-hand corner. It says Maralex-001883, so we can orient ourselves. And if you look at the entry for about 6:04 a.m. there, do you see that?
A. Yes.
Q. That looks like that's when the pressure first started to drop, right?
A. That's correct.
Q. And not the 7:15 in the morning that you'd expect from a 12-hour period, right?
A. I don't know why that pressure started falling there.
Q. All right. Let's look at the next page where we get to 7:15 in the morning. Do you see that there?
A. Yes.
Q. If you look at the top of that page where the pressure column begins with a pressure of 95.38 p.s.i.g. --
A. Yes.
Q. -- and then if you come down to, at the end of the 12-hour period, 7:15 in the morning, it shows 109.55 p.s.i.g. So there's an increase over that period, right?
A. That's correct.

Q. So that means injection has resumed at a higher rate over that period, right?
A. I don't know. It means the pressure increased.
Q. Well, but that's the period when the injection was occurring, right?
A. Supposedly, yes.
Q. Yeah, you weren't out at the field to observe the test?
A. No, I wasn't out in the field.
Q. So wouldn't that tell you, if the pressure was increasing, that the injection was likely increasing?
A. No.
Q. It tells you the injection had resumed, then, at some point?
A. No.
Q. How do you explain the increase?
A. It could be the pressure -- that they'd stopped injection and then resumed it, I'll admit that, I'm not going to deny it. It doesn't mean it, though. It could be you're injecting gas into the formation and, you know, filled up a fracture, suddenly the pressure tried to inflate that fracture, you know, so it's going to increase at a greater rate at that point in time. So the pressure could start increasing once it inflated a particular zone, and then it might break off and go -- or start inflating

another fracture -- You know, there's another explanation for it.

Q. So whatever the explanation, the pressure charts show what they show?

A. That's right.

Q. Let's look now at this graph. The Bates number at the bottom right-hand corner is Maralex-001896.

A. Okay.

Q. This graph, this shows the injection and the shut-down periods, right?

A. They more or less represent that, yes.

Q. Can you explain what caused the pressure to drop down and flatten out from roughly 30 to 33 hours and from about 35 to 44 hours into the process on this chart?

A. Well, to answer your question -- The short answer is no, I can't explain it. My guess is, it's one of the periods where they had problems with the compressor, so they either weren't injecting as much gas or lost all gas injection. That would be my guess. I wasn't out there, so obviously I can't explain it.

Q. Well, how does that make it flat, then, when the others show a curve?

A. I'm sorry -- How does the compressor problem make the --

Q. Well, all of the other injections and falloffs shown on the graph are shown by a curve, but for this period it's flat.

A. No, I would disagree. I mean, you look at the injection period right before that, if you go back up to the left, starting at about a time of 22 minutes, maybe, after that little -- there's a little brief shut-in, or whatever, caused -- I guess that's one of the compressor problems. Pressure builds up and then it declines a little bit, builds up a little bit, falls a little bit, declines a little bit, drops, it's flat for a few minutes.

You know, I wouldn't say all the other parts of this test the pressure is curving or increasing. You know, obviously -- That pressure is a function of how much gas we're injecting, and they were having some compressor problems out there. There was some fluctuation. This is not unusual to see some slight fluctuations in the pressure like this.

Q. You had a varying rate?

A. That's right.

Q. Just so we understand the period you analyzed, you looked at the falloff period from about 56 hours to it looks like about 80 hours on the chart; is that right?

A. That's one of the portions we looked at, yes.

Q. Okay. And the other analysis looked at the periods from about nine hours out to about 19 hours on the chart, right?

A. It looks more like about 8 1/2 hours out to 20-something hours.

Q. Okay. Let's turn to the page of the exhibit that has the Bates number -001898 on it. It's the chart.

A. Okay.

Q. And this is a chart of surface pressures, right?

A. I don't know that, but that would be my guess.

Q. You look in the center there, it tells you what time the chart was put on. What time was this chart put on, as shown there?

A. 6:15 p.m.

Q. On what date? July 12th?

A. July 12th.

Q. And this is an eight-day chart, right?

A. Yes.

Q. And so if you look at the chart, the first data was picked up at about 6:15 p.m. on the first day, then?

A. That's correct.

Q. Now, where is the first shut-in shown? Can you read that on the chart?

A. The first planned shut-in or the first --

Q. The first shut-in shown.

A. -- first problem shut-in.

Q. The first one shown there.

A. In the chart it looks like it's on the second day, occurring roughly at 8:00 a.m.

Q. Okay. Now, which do you think is correct, the times you used in your analysis, the times recorded on the downhole gauge or the times shown on the surface chart?

A. Well, the surface chart shows -- Oh, what is that? About 13 hours of injection. Because really, you know, it starts at six -- That's the time the chart came on. That doesn't necessarily mean that's what time they started injecting gas. It looks like maybe 6:30, 6:45, they've got the gas injection lined out, so call it seven o'clock. You know, that's 13 hours.

Q. Okay.

A. On this chart, which is run by a mechanical clock, by the way. So it could be off a little bit.

Q. Okay.

A. Whiting reported at approximately -- elapsed time of 12 hours injecting and an average rate of 760 MCF a day. That's the value we used in our analysis. So just to answer your question, I believed that the Whiting report was the most accurate value to use.

Q. All right.

A. Do you want me to do the analysis with 11 hours or 13 hours?

Q. That's all right.

A. You know, it's going to get the same answer. I would.

Q. On the test, how was the gas rate metered? Do you know?

A. No, I don't know.

Q. Do you know if it was an orifice meter or -- You don't know?

A. My guess is it's an orifice. Well, let me back up. I seem to recall Mr. O'Hare mentioning to me they were going to be metering the gas at the compressor station or -- What do they call that? DP or CDP or something like that?

Q. CDP.

A. CDP, something like that. And they have gas meters at those locations. And so I'm assuming it would have been a standard Barton orifice meter.

Q. Okay. But you don't know the actual location of the meter, its array?

A. No. I assume it's the same meter, though, that they're selling gas by, so it's probably pretty accurate.

Q. Okay. Let's look again at the Maralex data, the Exhibit -B. If you look at the pages with the Bates stamp number in the bottom right-hand corner, -001898, chart again, you have another chart at -001900, another one at -001902. Do any of these reflect the orifice size?

A. No, I don't see the orifice size on any of these charts.

Q. None of them show spring size?

A. No.

Q. So there's no way to tell whether these meters are properly calibrated, from these anyway?

A. No. I mean, there are ways to tell if the meters are properly calibrated, sure, but not from these charts.

Q. Okay. How is it that they can use the same meter they sell gas by?

A. Well, I assume that. I don't know that for sure, I'm sorry.

Q. Okay. Do you know whose gas was used for the test?

A. Yeah, it was Whiting's gas.

Q. Okay. Do you know if royalty was paid on that, injected what you used?

A. Of course not.

Q. You don't have to answer that.

Let's talk about the discussion on crossflow briefly here, before we break for lunch.

Referring back to your display BR-26 (a) you said that the pressure transient couldn't have moved through the Pictured Cliffs formation. Is it because you thought it would take too much gas to fill up the PC that quickly? Is that basically what you said?

A. No.

Q. Tell me what you said.

A. What we're showing here was that you couldn't see a 10-p.s.i. increase at this Chaco well until you injected enough gas to fill up the Pictured Cliffs, which would be in the tens of millions of cubic feet of gas.

When you're flowing gas from one tank to another, real simple, and you've got a valve here, and you've got to pressurize this tank down here 10 p.s.i. The pressure -- That pressure is directly proportional to the volume of gas in the tank.

And you can use my number, which is 66 million; you can use Mr. McCartney's number, which is a lot higher, which means it would take even more gas crossflowing down here to get 10 p.s.i. So that part of it has nothing to do with transients moving in the formation. This is simple volumetrics, simple reservoir-engineering principles.

Q. Well, how much gas would it take to fill up the coal so that you'd see a 10-p.s.i. change in the coal well 1800 feet away? Did you do that calculation?

A. No.

Q. Did you calculate how fast the pressure transient would have moved through the coal?

A. No.

Q. I understand that you disagree with some of the results and numbers that Mr. Cox testified to, but you don't disagree with the methodology he used. It was sound methodology, wasn't it?

A. I would characterize my opinion as I disagree with all of what Mr. Cox did.

Q. So you challenge the methodology in addition to the data he used?

A. Not the equations that he published. Those were basic equations for radial flow, you know, accepted methodology, principles.

Now, the way he applied them, I have a real problem with. And his definition of pressure travel time or whatever it was he called it, you know, I have never heard of that.

Q. Okay, but you didn't see any errors in his equations, I understand you to say?

A. Well, I didn't double-check him, so assume that he was at least going to put the correct equations down. I don't try to dig into that kind of stuff.

Q. Well, he provided the full details on his methodology, and you just didn't check it?

A. I didn't double-check the equations. I certainly reviewed his methodology.

Q. Is there any other analysis technique to compute how fast a pressure wave would move through either the coal or the Pictured Cliffs sandstone?

A. For hydraulically fractured coal seams, no. I've asked Dr. Lee if he could find for me any documentation in the literature that would substantiate calculations like Mr. Cox performed, and he --

COMMISSIONER LEE: Dr. Lee is not me.

THE WITNESS: That's not -- different Dr. -- Dr. John Lee, who wrote the Society of Petroleum Engineers textbook on pressure transient testing.

He has not been able to find the equations that you could properly make those calculations yet, but, you know, and I guess he'll keep looking.

Q. (By Mr. Hall) Okay. From an engineering analysis, then, you don't know if a pressure wave can move quickly enough through the coal to reach the Chaco 4 and the Chaco 5 within the times observed, correct?

A. Oh, sure, I do.

MR. HALL: Thank you, Mr. Robinson, I'm finished.

Madame Chairman, we'd move the admissions of Robinson-1, Robinson-2, Robinson-B and Robinson-C.

CHAIRMAN WROTENBERY: Any objection?

MR. GALLEGOS: No objection.

CHAIRMAN WROTENBERY: They're admitted.

Commissioner Lee?

EXAMINATION

BY COMMISSIONER LEE:

Q. Since we have this one, I don't understand your second scenario with all those fractures this side is not frac'ing down. Do you remember --

A. Yes, sir.

Q. -- where we talked about that? Can you explain it again?

A. Sure. Okay, opposite situation, we're going to block off this so that's not in communication. Okay. Now, when the Whiting well is shut in, the pressure in the reservoir is still declining. I mean, there's a pressure sink in this direction, so we're still going to have gas desorbed. That gas coming off is going into a confined system, basically. So the pressure is going to increase as more gas is desorbed off the coal, is all I'm saying. You've got a closed system.

Q. You're shutting Pictured Cliff and assuming it's connected to the Fruitland?

A. This is shut in, and it's connected.

Q. Connected, so what you're saying is, they still suck the gas into the Pictured Cliffs?

A. No, it's not really sucking the gas in there, it's just -- You know, it's like a pressure-monitoring well, as one of the witnesses testified to earlier. You know, so it's going to be able to read the pressure in the coal at this point in the field. And when that pressure starts increasing --

Q. Right.

A. -- due to the continued desorption of gas, then it's going to directly measure that.

Q. Suppose you have a pressure sink there, right? Then you shut it in. I think the pressure reading will increase, right?

A. If I have a pressure sink there --

Q. If you shut in, the pressure will --

A. Well, what would cause the pressure sink? Crossflow? Are you saying if I'm having crossflow here causing a pressure sink?

Q. In your system right now we're producing from the Fruitland Coal and right now we shut it in. What is the desorption? I thought desorption is going to be far away from that wellbore?

A. No, there's gas being desorbed right in and around this well.

Q. Yeah, but they've reached equilibrium, right, at this point?

A. Not necessarily. If the pressure in the reservoir is continuing to decrease, as exhibited by the decline, there will be additional gas desorbed, and it's coming down that isotherm curve.

Q. You're produced gas. Right now you've got a pressure equivalent, right

A. Right.

Q. Then you -- zoom, shut in, right?

A. Yes, sir.

Q. Then the pressure --

A. -- increases.

Q. Then readsorbed into the coal; is that true?

A. That's what will happen, right. If you start -- If you build that pressure up to a point up the isotherm curve, you could get gas readsorbing back into the coal.

Q. Okay. I only have 200 questions for you.

A. Oh, geez.

(Laughter)

MR. HALL: Please remain standing.

Q. (By Commissioner Lee) To be fair, I think I asked Dr. Conway about the discharge coefficient of your fracture model. What did you use?

A. Discharge coefficient?

Q. Yes.

A. Frankly, I don't. I hoped that it would be in the documentation I gave you. Trying to interpret Dr. Clarey's equations is like brain surgery to me. I can tell you, I believe he uses a point source as his interboundary condition.

Q. They need to input four parameters, four?

A. Right.

Q. Then solve it for the quadratic equation. So I'm hoping you can come up with a number compared to Dr. Conway's. Dr. Conway used .005, overall discharge coefficient. You don't even remember.

A. Oh, you're talking leakoff coefficient?

Q. Right.

A. Oh, I'm sorry, I apologize. No, what we did is, we input -- There's two was to do it in FRACPRO. You can input permeability in each layer --

Q. Yes.

A. -- and it will calculate the leakoff coefficient point. Or you can go ahead and input the coefficient for each layer.

Q. And what did you use?

A. What did I use? I used an average, I believe, of about .002 for the coal, somewhere in that neighborhood. And I'll get you the exact number.

Q. Pictured Cliffs?

A. Pictured Cliffs -- .002 in the coal, two three, in the coals. And in the Pictured Cliffs, .002. So roughly the same leakoff coefficient, a little lower in the Pictured Cliffs. Probably should be a lot lower, but there's some leakoff there.

Q. I think on your approach the Fruitland Coal should have a leakoff coefficient much higher than from your explanation, from your theory, don't you think so?

A. Yes. Now, there's another term we can put in there. It's called spurt loss coefficient, that probably better representing the fluid loss you see in the natural fracture. Leakoff coefficient, C_w, in how you use that in determining the coal, that is the leakoff into the matrix of the reservoir. So that's not a good number to use or representative of coal. Spurt loss is probably going to be probably a better number for coal.

Q. Do you know Dr. Clarey?

A. Yes, I do.

Q. Okay. You have four fractures. What's the orientation of those four fractures?

A. I don't know. The model doesn't consider orientation.

Q. So you just divided by -- your flow rate by four, to represent the four fractures, right?

A. Well, we divide the flow rate by four, we multiply the leakoff times four.

Q. Okay.

A. Okay, we do take into account, you've got four times more area. There is a method in the model to calculate the higher pressure due to the multiple fractures. When you think about it, if I've got two fractures growing side by side, and they're trying to open --

Q. Uh-huh.

A. -- they're competing against each other. This one's over here trying open up, and this guy over here is trying to open up. And so that generates additional pressure, because you have fractures competing for space within a confined -- a very stiff formation. So that causes the pressure to increase. So all of that's taken into account in the mathematics of the model.

Q. Well anyway, more variables.

A. More variables, those are in his equations, his lumped equations.

Q. Your expert, your colleague expert witness, he said -- I'll quote you. You say the Fruitland Coal and the Pictured Cliff, their source rock may be different. Now, as an engineer, you're taking this whole case -- I think it's very logical to check the origin of the gas, don't you think so?

A. To me it doesn't really matter. Maybe I'm wrong. You know, relative to geologic time we're looking at such a tiny, tiny slice of a period of time relative to geologic time when gas migrates into these reservoirs. Maybe it migrates out, maybe it doesn't. You know, I'm looking at something that occurred in a few years. And to get gas to flow from one zone to another, it has to have a direct communication, something much more than Mother Nature provided.

Q. Do you know the isotopes? Do you know what are isotopes?

A. Isotopes?

Q. Yes.

A. Roughly, generally, yes.

Q. You know, I think it's very logical to measure the isotopes if you have two different source rocks. It would very clearly distinguish between these two. But I personally do not believe that they come from two different source rocks, so...

Well, again -- Another question. This is -- We still have 196 to go.

The zone below the Pictured Cliff, you make a statement, you say there's 70-percent water saturation.

A. Yes, sir.

Q. What is the other 30 percent?

A. What is the other 30 percent? It's probably gas.

Q. So you're agreeing the gas is down there?

A. The gas is down there. It's probably, you know, irreducible saturation. If any of the gas flows, it will be minute amounts. But, you know, in tighter formations irreducible gas saturations are easily 20 to 30 percent. So the fact that there's 20- or 30-percent gas saturation down there doesn't mean they're going to produce it, as you well know.

Q. Okay, last question.

A. Last?

CHAIRMAN WROTENBERY: You missed a few.

(Laughter)

Q. (By Commissioner Lee) Your plot, the Exhibit Robinson-C, your dimensionless pressure, that's a very typical dimensionless pressure, ΔP^2 divided by --

A. Yes, sir.

Q. -- your dimensionless time, is that including the wellbore storage?

A. It includes wellbore storage and it includes the producing time effects.

Q. That particular variable, I'm talking about X direction.

A. Yes, sir, certainly.

Q. Now, go back to your real setup. You're doing the well testing. You correct your zero time, right?

A. Yes, sir.

Q. When you correct zero time, you're saying the bottomhole pressure has already pushed out some of the water?

A. Uh-huh.

Q. Then your wellbore storage coefficient, what's that?

A. The wellbore storage coefficient?

Q. (Nods)

A. The wellbore storage coefficient is just the --

Q. Let rephrase it.

A. Okay.

Q. I understand you understand the wellbore storage. I want to know, since your adjusted time when your gas has really pushed the water into somewhere, right, then start the transient or start the injection, then in your plot here you definitely use the CD wellbore storage coefficient, right?

A. Yes, sir.

Q. Wellbore storage coefficient minus then the unloading always in charge of the wellbore, you know, effect, to certain -- something like that?

A. Except in hydraulically fractured and naturally fractured coals, you should take into account the volume of the fracture --

Q. Yes, yes.

A. -- you know. In a conventional reservoir it's just the volume of the wellbore.

Q. Yes.

A. Exactly right.

Q. Suppose you already adjust your time, zero time, to the time the water already pushed out to the formation. Your CD, the wellbore storage coefficient, should be zero?

A. No, sir, because you've got also gas in there.

Q. Yes, but you already charge it.

A. Well --

Q. You would charge it to certain -- You adjust your time. The initial time, the zero time to whatever time this is affected by the CD, right? Right now you adjust your time to here. Then you're still using the whole wellbore as your CD, right?

A. Plus the fractures and the hydraulic fracture too.

Q. So if you have an uncertainty on this CD, then that will affect your calculation of your skin factor, right?

A. The skin factor, yes.

Q. Now, if you have your problem of your skin factor, then you have a problem with your --

A. -- permeability. It could be higher or lower.

Q. But I know you've done the best you can to interpret it.

A. Right. But you're right, if the wellbore storage coefficient is different, that will affect skin, which will affect permeability.

COMMISSIONER LEE: Okay, that's all.

COMMISSIONER BAILEY: (Shakes head)

CHAIRMAN WROTENBERY: I don't have anything either.

Mr. Gallegos?

MR. GALLEGOS: Well, I'm hesitant, but I've got a couple of questions, just to clarify something here.

REDIRECT EXAMINATION

BY MR. GALLEGOS:

Q. We spent so much time on your injection tests now. I don't think there was ever a description by you of what is the engineering principle that is being applied to arrive at the permeability of a formation by injecting gas through a well into that formation.

A. By engineering principles, you mean just the basic theory?

Q. Just basically what -- What the principle by which you can derive the permeability of the reservoir through this testing procedure?

A. Well, all of these theories start with good old Darcy's law, you know, and there are modifications to Darcy's law as we get into more and more complex situations, naturally fractured reservoirs and so forth.

So, you know, the principles behind the analysis are accepted throughout the industry, there's no question, pressure transient principles.

You know, we looked at a lot of different models. I mean, Mr. Hall walked me through four different types of reservoir models that we use. You know, there's not going to be any one of those that perfectly describes this behavior. But all of them collectively, we're getting the same answer within a reasonable range. And you know, if I would have tried the hydraulic fracture model and suddenly got 20 millidarcies, then I would have been real concerned. But I didn't. And I didn't try to force it one way or the other, I just matched data. The program calculates permeability, all I can do is match it, find the best match.

So, you know, this analysis, there's just no way to dispute it. I mean, obviously you can nit-pick at certain things and say this pressure should have been 1 p.s.i. higher, or this injection period should have been 30 minutes longer. Those don't really change the answer, that's not the issue. You know, the principles are here, and they're accepted.

Q. Whether or not the answer of 186 millidarcies on one case or 204 on another case is precisely right, is a matter of engineering principle, can you tell the

Commission this is a much more reliable basis for selecting the permeability of the coal reservoir than Mr. Cox simply arbitrarily assigning the 20 millidarcies?

A. Well, of course. I mean, that's why we wanted to run this test. We wanted to eliminate any assumptions about the coal permeability that anybody could make. So we elected to run this test to eliminate those issues.

MR. GALLEGOS: That's all.

CHAIRMAN WROTENBERY: Anything further, Mr. Hall?

MR. HALL: Nothing further.

CHAIRMAN WROTENBERY: Okay, thank you, Mr. Robinson, very much.

THE WITNESS: Thank you.

CHAIRMAN WROTENBERY: Before --

MR. GALLEGOS: Are we ready to adjourn the proceeding? Mr. Hall said we'd be finished by noon.

THE WITNESS: There it is.

MR. GALLEGOS: There it is, or a little after, but...

CHAIRMAN WROTENBERY: Before we break for lunch, we had some water analyses coming from several different sources, I think. Commissioner Bailey has requested those, and I know --

MR. CONDON: If I could for the record, this is just what I've marked as Exhibit W-39, which is Whiting's printout of the water analyses that we have available. I've also got a disc. I don't know if you want the information on disc, but I've got it on disc.

CHAIRMAN WROTENBERY: We don't need it.

MR. CONDON: Okay.

CHAIRMAN WROTENBERY: Thank you.

MR. HALL: The water analyses, we had were given by Mr. Busch to Ms. Hebert.

CHAIRMAN WROTENBERY: Okay, I guess make sure everybody has a copy of those. And I don't know -- How should we mark that? Do you have any suggestions, Mr. Hall, on marking it for identification?

MR. HALL: Cover letters for Mr. Thompson. Why don't we call it Pendragon Exhibit T-A?

CHAIRMAN WROTENBERY: T-A? Do you need some time to look at Exhibit T-A before --

MR. CONDON: Are you going to ask me some questions about it?

CHAIRMAN WROTENBERY: No, just before we --

(Laughter)

CHAIRMAN WROTENBERY: -- before I ask you if you have any objection to us introducing it as an exhibit in this case.

MR. GALLEGOS: There were water samples.

MR. CONDON: There are lots of other water samples.

MR. GALLEGOS: Yeah, I thought. Maybe not, I don't know.

CHAIRMAN WROTENBERY: Okay.

MR. GALLEGOS: These are still one sample, but I guess we don't have any objection.

MR. HALL: We have some additional analyses for individual wells. We don't have extra copies of them, but we'll make sure that you all get those. This is a compilation of some of the data from these individual analyses. We'll get you the entirety --

CHAIRMAN WROTENBERY: Okay.

MR. HALL: -- of the analyses as well.

CHAIRMAN WROTENBERY: Okay, and will we make that part of T-A or --

MR. HALL: Yeah, a supplement to T-A.

CHAIRMAN WROTENBERY: Okay. Shall I just give that to you, and we can take care of that later then?

MR. CONDON: Could I just address one more little housekeeping evidentiary matter?

CHAIRMAN WROTENBERY: Sure.

MR. CONDON: This is -- I haven't tendered yet W-1, which is one of the exhibits that Mr. Hall indicated that he had no objection to, in our W exhibit list. It's just the copies of the transfers of operating rights. So I just want to make sure that you all -- I don't -- If you each want a copy of them I'll be happy to give you each a copy, or I'll just give one copy for the record, but --

CHAIRMAN WROTENBERY: Probably just one copy for the record will be fine.

MR. CONDON: Okay.

CHAIRMAN WROTENBERY: I think we stipulated to that one, right?

MR. CONDON: Yes.

MR. HALL: Yes, no objection to that.

CHAIRMAN WROTENBERY: Okay, yeah.

MR. GALLEGOS: Was our water sample marked as an exhibit?

CHAIRMAN WROTENBERY: Your water sample is W-39, and they're admitted into the record.

And I wanted to ask, too, I know, Mr. Gallegos, yesterday you had objection to the introduction of Brown-20. This was the --

MR. GALLEGOS: Yes.

CHAIRMAN WROTENBERY: -- invoices from Englehart Oil Field Maintenance.

MR. GALLEGOS: Right.

CHAIRMAN WROTENBERY: I wanted to give you an opportunity to -- Now that you've had a chance to look at it, I don't know if there's any of your witnesses who could enlighten us on this particular exhibit and what its meaning is.

MR. GALLEGOS: I think -- Yeah, I think it can be explained, yeah, by Mr. O'Hare, if we need to, as far as what was --

CHAIRMAN WROTENBERY: I'd like to, if that's okay, recall Mr. O'Hare then and have him comment on it.

MR. O'HARE: Do you want me to take the stand?

CHAIRMAN WROTENBERY: If you wouldn't mind. You're still under oath.

Do you want to use this copy?

MR. CONDON: Yeah, could we, because I don't have any idea where our copy is.

CHAIRMAN WROTENBERY: Okay.

ALEXIS MICHAEL "MICKEY" O'HARE (Recalled), the witness herein, having been previously duly sworn upon his oath, was examined and testified as follows:

MR. O'HARE: I'll try to explain this. I need to point out on the map that there is a gathering system that includes our wells in Section 1, the Gallegos Federal 26-13-1 Number 1, the 26-13-1 Number 2, and then there are also other wells that are operated by another operator that are tied into the same gathering system. Those wells are located in Sections 11, 10, 3 and 9 of 26-13 -- Township 26 North, Range 13 West.

At this point in time we had decided that there was more back pressure on all of the wells on that gathering system than the two operators were happy with, and that was due to the fact that all water from all of those wells was being pumped through an underground gathering line to the 1 Number 1 location and stored in the storage tanks on that location.

So what this work entailed was to disconnect each well from that gathering system and set individual fiberglass tanks at each well site and then take that -- it was a 2-inch water line, and convert it from a water line to a gas line. So now gas from each of the wells was going through two separate lines down to the CDP on the 1 Number 2 location. And that's what these tickets represent, the work done to accomplish that.

EXAMINATION

BY MR. GALLEGOS:

Q. Were you adding any compression?

A. No, sir, compression was already in place on the 1 Number 2 CDP at this time.

CHAIRMAN WROTENBERY: Okay, thank you.

Mr. Hall, did you have any questions?

EXAMINATION

BY MR. HALL:

Q. Make sure I understand what the testimony is.

Was there compression on the 13-1 Number 2 from the period of February, 1998, to February, 1999?

A. I don't know the exact date when the compressor was turned on, on the 1 Number 2 CDP, but there has been compression at that CDP for an extended period of time.

MR. HALL: Okay, that was all. Thank you.

CHAIRMAN WROTENBERY: Okay. Did you want to ask him any questions?

MR. CONDON: (Shakes head)

CHAIRMAN WROTENBERY: Okay, thank you very much for clarifying that.

Do you have anything more, then --

MR. GALLEGOS: No --

CHAIRMAN WROTENBERY: -- Mr. Gallegos or --

MR. GALLEGOS: No, Madame Chairman, members of the Commission. That completes our case.

CHAIRMAN WROTENBERY: Okay. Mr. Hall, what does your rebuttal case look like at this point? How many people are you going to call, who are they going to be, how long will it take?

MR. HALL: We have three fact witnesses to call for rebuttal, and I think they can be fairly short. We'll also recall Mr. Nicol, Mr. Cox and Mr. McCartney for rebuttal.

CHAIRMAN WROTENBERY: Okay. I trust this will be cumulative testimony? I mean, we've already covered a lot of these issues --

MR. HALL: Yes. No, we --

CHAIRMAN WROTENBERY: -- on numerous occasions, and --

MR. HALL: I understand the concern. We're -- It should be pure rebuttal to address testimony from the Maralex/Whiting witnesses --

CHAIRMAN WROTENBERY: Okay.

MR. HALL: -- is the purpose.

CHAIRMAN WROTENBERY: Have you got any estimate of time this afternoon?

MR. HALL: You know, I hate to do that.

CHAIRMAN WROTENBERY: I know, you're not very good at it --

(Laughter)

CHAIRMAN WROTENBERY: -- but I keep asking anyway.

MR. CONDON: The record should reflect that he chronically understates the amount of time that it's going to take.

COMMISSIONER LEE: Well, but you guys spend a long time too.

MR. CONDON: We didn't tell you it would be short.

CHAIRMAN WROTENBERY: I feel compelled to ask.

MR. HALL: Well, I'd suggest we break for lunch in any event. But I'll try to keep it as concise as we can. I understand --

CHAIRMAN WROTENBERY: We'd appreciate that.

MR. HALL: -- we've been here a long time --

CHAIRMAN WROTENBERY: I think everybody will appreciate that.

MR. HALL: -- and I certainly appreciate your patience.

We're not going to go into the night. I would think we could do it all in two hours.

CHAIRMAN WROTENBERY: That will be our goal then.

MR. CONDON: Could we be heard, though, when we first come back? I'd like to just make a record on just a general objection to rebuttal testimony for the record.

CHAIRMAN WROTENBERY: Yes.

MR. CONDON: Thank you.

CHAIRMAN WROTENBERY: Thank you, we'll take that up right after lunch, then.

Let us break until 1:30 for lunch.

(Thereupon, a recess was taken at 12:18 p.m.)

(The following proceedings had at 1:32 p.m.)

CHAIRMAN WROTENBERY: Ready?

MR. HALL: Yes, ma'am.

MR. GALLEGOS: Yes.

CHAIRMAN WROTENBERY: Mr. Condon, you wanted to make a comment?

MR. CONDON: Yes, ma'am. What I wanted to do for the record was move for an order from the Commission that there be no rebuttal testimony in the case, or, barring that, that any rebuttal testimony be strictly limited to issues that arose from Whiting's witnesses that would not and could not have been anticipated in Pendragon's case-in-chief.

And I want to just take a minute to talk about the law on rebuttal.

Rule 40, which Mr. Hall cited to yesterday, does have a Rule 40.C, a sequence of trial, which calls for opening, response and rebuttal, and then says specifically, "the court may -- " and of course, here it would be the Commission may " -- in its discretion permit any party to introduce additional evidence", which we may contend, depending on the evidence that Pendragon attempts to put on in their case, ought to give us the opportunity for surrebuttal.

And I would like to hand out to the Commission -- I don't know how many of you want copies of the cases. All right, this is the New Mexico case of State vs. Doe, in which Judge Walters for the Court of Appeals in 1983, if you turn to the third page, in the right-hand column -- the case is important, first, for saying that you've got discretion to determine how much rebuttal or surrebuttal to let in. But it also says a defendant should always be permitted to introduce in surrebuttal such evidence as tends to meet new matter introduced by the prosecution on rebuttal.

And I just want to point out the law on the standards for rebuttal testimony. First of all, rebuttal is not a vehicle to allow a party with the burden of proof to introduce evidence which should have been produced in its case in chief. And there are a number of cases:

Bowman vs. General Motors at 427 F. Supp. 234, and I have copies of that case.

Upshire vs. Shepherd at 538 F. Supp. 1176.

Harold vs. Fiberboard, 1989 West Law at 145810.

Second principle, rebuttal is not a vehicle to allow a party to rehash, reiterate or restate its testimony in the case in chief. So to the extent that the Pendragon witnesses may get up and give the same opinion testimony that was contained in their reports and in the testimony that they gave, refer back to the same exhibits that they've already testified about, then there may be objections that get raised during the course of that testimony, depending upon how far Pendragon attempts to go with that.

The Commission is well aware that we've had prefiled testimony in this case and an opportunity to review that prefiled testimony before the case-in-chief was put on. We have consistently argued since the very first proceeding in this case that there is communication between the two formations and that the communication comes out of the Chaco wellbores, and that the Chaco wells have been producing Fruitland Coal gas from 1995 until they were shut in, in 1998.

So of course it's our position that Pendragon's case was well aware of what we were going to prove, there were no surprises in that evidence. And for the most part, most of what Pendragon wanted to introduce as evidence in the case should have been put on in the case-in-chief.

If the Commission does allow the rebuttal testimony -- and like I say, if there are new matters that are introduced during that rebuttal testimony, then we may request surrebuttal.

CHAIRMAN WROTENBERY: Thank you. I don't know if you want to respond, Mr. Hall?

MR. HALL: I understand Mr. Condon is simply making an objection for the record. I don't care to respond at this time.

CHAIRMAN WROTENBERY: Okay. I would just like to clarify that, first of all, we talked about the rebuttal testimony very early on in the proceeding, if not at the outset, and it was -- I think it was in the first day, fairly early on in our time here together, and we did not provide for the submission of prefiled rebuttal testimony, so we have allowed it really at various points through the proceeding. I mean, Whiting and Maralex have had an opportunity to present additional direct testimony because of the fact that we didn't provide for rebuttal testimony in prefiled form. We've spent, really, more time on direct with each of the Whiting/Maralex witnesses than we did wit the Pendragon witnesses as a result.

I do think that what we need to do here is go ahead and give Pendragon the opportunity to rebut what they had heard during Maralex and Whiting's presentation. We've already talked about the fact that we really don't want to go into just cumulative evidence things that we have heard before, as you have said --

MR. CONDON: That's correct.

CHAIRMAN WROTENBERY: -- appropriate material for --

MR. CONDON: Right.

CHAIRMAN WROTENBERY: -- for rebuttal testimony.

MR. CONDON: Yeah, and --

CHAIRMAN WROTENBERY: But we do want to give them an opportunity to respond to --

MR. CONDON: Right.

CHAIRMAN WROTENBERY: -- new material that may have come up.

And we can -- However they approach it in the courts, the Commission tends to be probably a little more informal in its proceedings, and there are times that we allow surrebuttal, I guess is the right terminology.

MR. CONDON: We're not saying we're definitely going to ask for that.

CHAIRMAN WROTENBERY: Uh-huh.

MR. CONDON: What we just want to do is reserve the right to see what comes out during the rebuttal and make a determination at that point if there's anything else we think we need to tender.

CHAIRMAN WROTENBERY: We are trying to be fair to all the parties and err, if anything, on the side of hearing more rather than less than we need.

MR. CONDON: This is why we're here Saturday afternoon.

CHAIRMAN WROTENBERY: Exactly. So without more, let's go ahead and --

MR. HALL: I appreciate it, Madame Chairman. I'll certainly try to expedite.

At this time we'd recall Paul Thompson to the stand.

CHAIRMAN WROTENBERY: Mr. Thompson, you're still under oath.

MR. THOMPSON: I understand.

PAUL THOMPSON,

the witness herein, having been previously duly sworn upon his oath, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. HALL:

Q. Mr. Thompson, you were present for the testimony by the Whiting/Maralex witnesses, including Mr. O'Hare, and there was much made of the recordation and reporting of the water production from the Chaco wells. Do you recall that testimony?

A. Yes, I do.

Q. Let me hand you some materials. They come from Exhibit A-12, Ancell-12, which is the compilation of the pumper reports for the Chaco wells. And for the Chaco 4 well you have selected two reports, have you not?

A. Yes, I have.

Q. And what are the dates of those two reports?

A. One is March, 1998, the other is April, 1998.

CHAIRMAN WROTENBERY: Where would we find those in our exhibits? Could you help us out?

THE WITNESS: Ancell A-12, and then under

Chaco 4 --

CHAIRMAN WROTENBERY: Chaco 4.

MR. CONDON: It's the third section. The copies we have are demarcated by orange --

CHAIRMAN WROTENBERY: We've probably got --

MR. CONDON: Right.

CHAIRMAN WROTENBERY: Yeah, okay. We have more than two reports under that, so I was --

THE WITNESS: Well, I've just picked out these two as an example. There's been a lot of talk about our attempt to either not report, to hide water production, and I'd like to explain. I explained this during the Commission hearing but would like to go on over again for your benefit, what happened here.

And what I've shown here is like a before and after.

Early on in our work on these wells, our client, who at the time was Edwards Energy, asked us to please type up our pumper's reports because they're having a hard time reading them. And at some point we developed this form that you'll see for March, 1998. And the people -- my people in the office would take the data from the pumper's report and type it on this computer, just tabulation, and send it off to Edwards.

And at some point -- and this is totally my fault, and that's what I want to explain -- we omitted the water column. As you'll see on the handwritten copy of the report that we went back to in April of 1998, after this became an issue, there is a column there next to the MCF column that lists water.

And the procedure normally is to try to take a bucket test, in which you hold a five-gallon bucket over the end of the separator and time how long it takes to fill up the bucket, once a week, and the pumpers will report that water volume in the water deal.

On the typed reports, the only time the water was listed was if the pumper happened to write the water number in the comments column, which normally they would put something in the comments column during a workover or, you know, if we were installing a new compressor, trying a piston or something was different, would they put the comment in the comments column. And then that subsequently is the only data that was reported.

Unfortunately, then, we sent these same typewritten reports to the client, who then used them to prepare his C-115. And if we didn't tell them about the water, they obviously didn't report any water. That's our fault.

We don't intend to imply that the wells didn't make any water or that we're trying to hide the water; it was just totally a clerical screw-up, and I take responsibility.

Q. (By Mr. Hall) Mr. Thompson, was there any intent, as Maralex says, to hide water production?

A. No, there was not.

Q. All right. We had some discussion by the witness Mr. O'Hare of his Exhibit AMO-6, which he represented reflected water production from the Chaco wells. Do you have that in front of you?

A. Yes, I do. Again, primarily the only numbers that would be recorded in the comments column would be something that's different than normal operations.

So consequently until you see that -- the period of March of 1998, or April of 1998, where we went back to the old form, all these other ones really had to do with -- for example, the Chaco Number 1 in March of 1995, that 40 barrels a day is a one-time reading, and that's real close to the time we fractured the well. So that's probably frac fluid flowback, and that's why it was in the comment column.

Again, around July, August and September in the Chaco 2-R, we set a compressor on the well at that time, and that's why the pumper would report that abnormally high water production in the comments column.

Farther down, in April we installed -- or excuse me, in May and April, on the Chaco 1 and Chaco 4, we installed compressors, and that's why the numbers seem to be a little bit higher.

In my trips to the field, which were irregular but probably about once a month, you know, I observed intermittent trickles of water coming from the separators. And some of the wells I did see fluid in the bottom of the pits. I always estimated that without doing a bucket test, in my mind, somewhere on the order of 5 to 10 barrels of water a day.

And those numbers were confirmed by the State test. We actually set fiberglass pits out on the wells, and these tests were observed by Mr. Busch at the Aztec office of the OCD. And in February of 1998, you know, the numbers were at the high, 13.9 barrels from the Chaco 2-R, 5 barrels from the Chaco 4, and the Chaco 5 and Chaco 1 weren't making any water at all.

Q. Why didn't you just continue to produce into the fiberglass pits, as long as you had them out there, fiberglass tanks?

A. Well, we don't really need to, less than five barrels of water a day.

Q. Did the Division authorize the removal of the fiberglass tanks?

A. They explained to us that the pits were required only for the test.

Q. You were producing into unlined pits, correct?

A. That's correct.

Q. Is that permitted by the Division?

A. Yes, it is, outside the vulnerable area.

Q. These wells are outside the vulnerable area?

A. Yes, they are.

Q. Mr. Thompson, are you aware of other operators in the area who have been frac'ing into the PC recently?

A. Yes, I am.

MR. HALL: I have no further questions for Mr. Thompson.

CROSS-EXAMINATION

BY MR. CONDON:

Q. A few. Mr. Thompson, would you -- You've been around in the San Juan Basin for a number of years, have you not?

A. Yes.

Q. And so you're generally familiar with the reporting rule and regulation requirements of the Oil Conservation Division with respect to gas and water?

A. Yes.

Q. Okay, and you've been familiar with those rules for how long?

A. I started working for Northwest Pipeline in 1979.

Q. So you've been in the Basin for about 20 years?
A. Yes.
Q. And that entire time you've been familiar with those rules and regulations?
A. They change, but I try to keep up.
Q. And in that 20 years, have you worked on both Pictured Cliff and coal wells?
A. Yes.
Q. And are you familiar with the water-production characteristics of a coal well, as opposed to a typical Pictured Cliff well?
A. Yes.
Q. And you're aware that one of the characteristics for distinguishing those two wells is water production?
A. Yes.
Q. Okay, and you were aware of that in 1995 when you oversaw the work on the Chaco wells?
A. Yes.
Q. Okay. Now, you testified, I believe, that you used the old form, which did not have a column for reporting water production, and I would like you to take that section from Exhibit A-12 that deals with the Chaco -- Well, let's see. Let's start at the beginning of A-12, if we could, and the first well that's reported there in the packet, as I have it, is the Chaco 1. Is that how you're

set up also?

A. Yes.

Q. All right. And if you'll go back to the dividing line, where you get to the Chaco 1-J -- I figure it's probably about 30 pages in --

A. On the Chaco 1?

Q. -- and the report that we have, the first report that we have in here for the Chaco 1, is February, 1995. Do you see that?

A. Yes.

Q. Is that a Walsh Engineering and Production well report form?

A. Yes.

Q. Okay, does that have a column for water production?

A. No, it does not.

Q. Okay. When you say you went back to the old form, how far back in time do we have to go before we find a Walsh report that includes a column for reporting water production?

A. Well, I couldn't really say because unfortunately we didn't keep any of the handwritten copies.

Q. Well, I'm talking about the form that Walsh uses, this well report form. Are you responsible for preparing the well report form for Walsh Engineering?

A. No.

Q. Okay, who was?

A. Probably just someone in my office staff makes up these forms.

Q. Okay, but are you the president of --

A. I -- yes, I'm responsible.

Q. -- Walsh Engineering?

A. Yes.

Q. So you're ultimately responsible?

A. Yes.

Q. So I guess my question is, can you tell us as we sit here today, when you say "going back to the old form", when was it that Walsh Engineering and Production had a well-report form that had a column for reporting water production?

A. I can't tell you that.

Q. But does Walsh Engineering and Production use two different types of well-report forms, or do you have just well-report form that you use for all the operators that you work for?

A. Actually, we have multiple forms, and it usually depends on the client.

Q. Okay. So during this period of February, 1995, until February of 1998, that three-year period, did you have some clients that you used well-report forms that had a column for reporting water production?

A. I'm sure we did.

Q. Okay. Could you provide some of the -- You can redact out the name of the client, but I would request that we have a copy of a representative sample of the other kinds of well-report forms that you had available to you during this period that --

A. Could you give me the period again, please?

Q. Sure, February, 1995, to February, 1998.

A. Okay.

Q. Then I believe you said you were out at these wells approximately one day a month?

A. Probably.

Q. Okay. If we could, let me just ask you a couple questions. If you go back to the Chaco 1 section on the well-report forms, if you go in about four pages to the June, 1998, date, have you got that?

A. Yes.

Q. Okay, and by this time you had changed back to the report form that has a column for reporting water production?

A. Correct.

Q. Okay, and the change in terms of adopting a well-report form for Pendragon and Edwards that had a column for reporting water production specifically, that came after the meeting and the well tests and the water tests that were sponsored by or done at the request of the Aztec Division Office?

A. We quit typing the data at that point.

Q. Okay, well, let me ask you a question about that. As I understand your testimony, what would happen -- and I guess it happened, as I'm looking at these forms, pretty much for the entire period from February of 1995 until February of 1998, is that your -- Was it the pumpers who were responsible for filling these forms out?

A. The pumpers would fill out a form that looks like this one you're referring to with the handwritten stuff. They would take them into the office, and then they would just be typed up by the clerical staff there.

Q. Okay. Are the copies that the pumpers actually prepared out in the field still available?

A. No, unfortunately not.

Q. What happened to those?

A. Well, we just threw those away.

Q. Okay. You didn't -- So they were just thrown away routinely as the reports were typed up?

A. Yes, after we typed up the typed ones, we threw away the handwritten ones.

Q. Okay, after -- And how did that work in your office? Who was responsible for typing up the forms?

A. I only have two people that do that work. It would be Ruth Rogghe and Evelyn Ward, and I'm not sure, you know, whether -- who would do it. They might change month to month or -- depending on the workload.

Q. Did you ever check the reports that were actually typed up against the pumper reports that came into the office?

A. No, I didn't.

Q. Going back to the June, 1998, report for the Chaco 1 -- and that does have a column for water production --

A. Yes.

Q. -- if you go down to, I believe it's June the 3rd, it's got a report of zero barrels per day; is that correct?

A. That's correct.

Q. And then there's no entry for seven days, and then an entry of 21 barrels per day; is that correct?

A. That's correct.

Q. Okay. In your experience is it typical for a well in this area to have zero water production for a number of days, then all of a sudden have water production at a rate of 21 barrels per day, and then for the rest of the month show no water production at all?

A. Well, you can see there's other things going on with the well.

Q. Okay. But I mean for a lot of the days that well was producing, was it not?

A. Yes.

Q. I mean, if you look at the MCF column, you see that the well was actually producing for what, about 28 of the 31 -- or actually 27 of the 30 days in June?

A. That's correct.

Q. Okay, but there's only one day where there's recorded and reported on these well report forms any water production for that well; is that correct?

A. Right, when the compressor was running.

Q. Okay. Now, are you telling us as we sit here today that we can look at this report and know for certain that the only day that that well produced any water in June of 1998 was -- I believe if you go over, it's June 10th?

A. No, that's the only day we checked it that week. That's what I said. We normally take a bucket test once a week --

Q. Okay.

A. -- and report that number.

Q. Okay. If a well is producing and there's no other condition that's inhibiting the production of the well, would you expect if a well like this produced 21 barrels per day on that date, that it was probably producing a similar amount of water on the other days around that period of time?

A. Yes, I'd say that's true.

Q. All right. And then if you'll just flip back to May of 1998, which is the next month back, and there again we have a month where the well appears to be producing every day, and this is three years after the fracture-stimulations, correct?

A. That's correct.

Q. And this is, in fact, the last month that the well produced before it was shut in?

A. This is also the second month after we put the compressor on.

Q. Okay. So the well was producing -- You'd call those pretty good volumes, wouldn't you, of gas?

A. Yeah, it seems pretty normal for this well.

Q. Okay. And of the 31 days in May of 1998, there are only four days where the water production is recorded at 21 barrels per day --

A. That's correct.

Q. -- do you see that? All right.

Now, again, would it be your assumption that the well was producing similar amounts of water on the other days in May of 1998 --

A. Yes.

Q. -- if it was producing 21 barrels a day on those four days where it was measured?

A. Yes.

Q. Okay. And where was that water going at that point in time?

A. Going?

Q. Yeah, where was the water flowing to?

A. We have a pit there.

Q. Okay, is that an open, earthen pit?

A. Yes.

Q. Okay, what is the nature of the soils in that pit?

A. Sandy.

Q. Will water percolate into the soil if it goes into a pit with that type of soil?

A. Yes.

Q. And do you know how much water production Pendragon reported in May of 1998 on the C-115 --

A. No, I don't.

Q. -- report?

And if you turn to April of 1998, do we have essentially the same condition there, where the wells seem to be operating for the entire month of April, but there were only four days when water production was noted and recorded?

A. That's correct.

Q. Okay. And again, given the production volumes on that well, would you have expected that that well would produce similar volumes of water on the other days for which there is no reporting?

A. Yes.

Q. And aside from the possibility that you or one of your pumpers or somebody from Pendragon would have been out at the well to record that water production, is there a way to record it?

A. No.

Q. And just so I'm sure the Commission understands, let's just look at that first report of water in April of 1998, and I think it corresponds to April the 8th, 29 barrels per day, do you see that?

A. Yes.

Q. Okay. How were those measurements taken

A. Probably with a -- like I said, a bucket test.

Q. Well, do you know, I guess, is the first question? Do you know how they measure --

A. That's the only way we check these.

Q. Okay, and how does the bucket test work?

A. You stick a bucket over the end of the drip and you time how long it takes to fill up five gallons and then extrapolate to barrels per day.

Q. Barrels per day. Now, I'd like you to turn back to March of 1995 for the Chaco 1, if you would.

A. Okay.

Q. Do you see that? Okay, and are there a couple of references down there at the bottom of the page to water production from the well in Mach of 1995? Do you see those?

A. I see -- Yes.

Q. Okay, March 21st, I believe, is 30 estimated barrels per day?

A. Correct.

Q. And then the 29th it's 40 barrels of water per day?

A. Correct.

Q. Again estimated. Do you know how those estimates were taken?

A. I'd say bucket tests again.

Q. Let me hand you, if you could, what I've marked as Exhibit W-41.

Now, as I understand your testimony, the well-report forms like the one that's here and -- Oh, I'm sorry. That's in Exhibit A-12. Those were the forms that were then sent on to your client. At that time it was J.K. Edwards with respect to the Chaco wells; is that correct?

A. That's correct.

Q. Okay. If you will turn in the -- what I've marked there as Exhibit 41, and if you go back about -- It's a number of pages, I would say a little more than halfway through, and it's the C-115 report for March of 1995, is that the date that corresponds to the well-report form that we're looking at?

A. Okay.

Q. Have you got that? And then page 8 of 9, page 8 of 9 in the March, 1995, C-115 --

A. Okay.

Q. -- do you see that?

A. Yes.

Q. Okay, and do see the Chaco 1 listed about four wells down?

A. Okay.

Q. And what does the C-115 report say in terms of barrels of water produced for March of 1995?

A. It says zero.

Q. All right, is that accurate and in keeping with the information that you have from your well-report form?

A. We didn't actually tell them what it was, so they just put zero, I guess.

Q. Okay, but they got this well-report form?

A. Right.

Q. And again, for a well like this, that was, as I look at this, from the 21st of March on, to the end of the month, it was producing gas continuously; is that correct?

A. Yes, just first delivered.

Q. Right. And you've got a notation that water is being produced on the 21st and again on the 29th. In your experience, given this sort of gas production from a well like this, would you also expect that in the interim between March 21 and March 29 that well was also producing water?

A. Yes, if I had done the C-104 I probably would have -- or the -115, excuse me.

Q. Okay. But you didn't do that?

A. I didn't do that. No, if we don't tell the client what the water is, they probably don't report it, you know.

I don't think that he was intentionally hiding anything; he didn't know any better. I mean, I'm sure he has a secretary that types these things up. He might have sent them off to a service that does this, and they sure as heck aren't going to assume anything from our data.

This is 100-percent a Walsh problem. We didn't tell them what the water was accurately for them to report it, so they just don't report it.

Q. Well, do you know what they did internally once they received your well-report form?

A. No, I don't, actually.

Q. Okay, so that's -- What you just said was speculation --

A. Right.

Q. -- on your part?

MR. CONDON: I'd ask that that be stricken from the record, or that you at least disregard the speculation.

CHAIRMAN WROTENBERY: We'll take it for what it's worth.

Q. (By Mr. Condon) Is there a limitation on how much water you can produce into an unlined pit even outside the vulnerable area?

A. It's five barrels of water a day.

Q. Five barrels a day?

A. Yes, on a monthly average.

Q. Okay. So this was outside of the vulnerable area, but at least for the Chaco well -- and I'll represent to you that I can walk through the same kind of analysis on the 2-R and the 5 -- based on the documents that are included in Exhibit A-12, are the volumes from March 21 through March 29 of water that was being produced in excess of five barrels of water a day, according to your well-report form?

A. I'm sorry, which well are we talking about now?

Q. The Chaco 1.

A. Okay.

Q. And I'm looking at the March, 1995 --

A. Yes. Yes, they were.

Q. Okay. And so why was the water being dumped into an unlined put?

A. Well, this is flowback after a frac job. You know, we assume we're getting a lot of our load water back.

Q. So you're getting flowback as well as the well is producing?

A. Right.

Q. All right, what about in March of 1998? You don't think that's flowback, do you?

A. Actually, that's -- No. That's, you know, what we thought probably would be, when we put the compressor out, maybe a short-term, you know, increase in the water production, which it seems like it was. By June it's down to five barrels.

Q. Okay. But for the period -- Well, in June --

A. You're technically correct, that's right. You know, if five barrels a day is the limit, we're over five barrels a day.

Q. Okay. And at any point in time did you recommend to Edwards or Pendragon that you should line those pits?

A. No, I don't believe I did.

Q. Okay. Did you recommend that you should perhaps put some sort of a disposal unit on the property in order to retain the water so that it doesn't go into unlined pits?

A. A tank, you mean?

Q. A tank, sure.

A. No, I didn't.

Q. Okay. Do you know how much -- If we go back to the March of 1995 period, from March 21 through March 29, if you -- Let's just say you average the 30- and the 40-barrels-of-water-per-day figures, the two figures that you have on there.

From that period to the end of the month, how much water would you figure that well actually made that -- total, not just what was reported, but total amount of water that well made for the month of March of 1995?

A. Take an average of 35 barrels a day, times ten days, it's 350 barrels.

Q. Okay. Now, as you -- I see no evidence of water production being reported through most of 1996 on that well; is that correct?

A. Probably not on the typed forms, no.

Q. Okay. Do you know if during the period from -- Let's see. Say April of 1995, and as I went through here the next reference that I saw to water production from the well was April of 1998. Can you tell us for certain whether there was no water produced from this well during that period?

A. There was some water produced during that period.

Q. Okay. And what is your best guess at this point of the levels of that production?

A. I would guess between 5 to 10 barrels per day.

Q. Okay. So 5 to 10 barrels per day, at an average of 30 days a month, would be anywhere from 150 barrels of water to 300 barrels of water a month; is that correct?

A. That's correct.

Q. And do you know if Pendragon reported any water production at all on the C-115 reports for this well during that entire period of time?

A. I don't know, but I would suspect not since I told them nothing.

Q. I'm sorry, since you told them what?

A. I didn't tell them anything, so I would suspect that they did not report anything, but I don't know that.

Q. Okay. But as we've seen, even in the months where your well-report form told them about water --

A. Well --

Q. -- in some instances it didn't get reported, correct?

A. -- you know, it wasn't clear, here's how much the water made, to where at the total -- at the, you know, total column, some clerk could go and put in the number in the water column. You know, not specifically -- specific enough to do that, to fill out the form properly.

Q. Okay. Well, do you know anything about the experience of the folks at Edwards or Pendragon in terms of reporting water production on the C-115 report?

A. No.

Q. You don't know what their experience was?

A. No.

Q. So again, you're just speculating as to what they may or may not have done when they received your well-report forms?

A. Yeah, I can only assume that if I don't tell them what the water is, they're not going to report it.

Q. Okay. Well, wouldn't an experienced operator who received a report like that, wouldn't you expect an experienced operator, before they put zero down on the C-115 report form, to call the pumper or the contract company and say, Look, I've got some evidence of water production from this well, what should I put?

MR. HALL: Madame Chairman, I think at this point I'm going to have to object. I think we've exceeded cross-examination and crossed into the realm of discovery at this point. This has gone on a long time.

MR. CONDON: That's okay, I'll let the question stand without an answer, that's fine.

Q. (By Mr. Condon) Let me ask you, Mr. Thompson, a couple of other questions about Exhibit W-41, if I could.

If you'll just turn to the second page of that document, do you see that?

A. Yes.

Q. That's the January, 1995, C-115 report form. And at the top there's a designation, "Basin Fruitland Coal (Gas)"; is that correct?

A. That's correct.

Q. Okay. And the Cowsaround 21-1, is that the well that we've been talking about that's in close proximity with and set up on the same CDP as the Chaco Plant 5?

A. That's correct.

Q. Do you know when that well was established as a coal gas well?

A. It was drilled as a coal gas well.

Q. When was that?

A. I'm not sure. It was drilled prior to my employment with Edwards, by McHugh.

Q. All right, so you don't have any idea when it was drilled?

A. No.

Q. Early 1990s?

A. I guess.

MR. HALL: Madame Chairman, I just think this is getting way beyond the scope of the direct, rebuttal attempt --

MR. CONDON: It's cross-examination, Madame Chairman, and the issue in this case is the reporting of water production and the failure to report water production. Here we have --

CHAIRMAN WROTENBERY: Overruled.

Q. (By Mr. Condon) Thank you. Mr. Thompson, there are four coal gas wells that are listed on that page, and not a single one of them shows any water production; is that correct?

A. That's correct.

Q. Okay. Were those wells, in fact, producing water --

A. Yes, they were.

Q. -- at that point in time?

A. Were they significant volumes?

A. When is this? 1 of 1995?

Q. March -- Or January of 1995.

A. I believe so. I'm trying to think -- Probably, yes.

Q. I mean, given the levels of gas production that you see from those wells, you would expect that there would be --

A. Yes.

Q. -- some significant, measurable volumes of water being produced --

A. Right.

Q. -- is that correct?

A. Yeah, I was just trying to get my timing right.

Q. And are you the contract pumper on those wells also?

A. Yes.

Q. All right. Did you use the same well-report form during this period of time that did not include the column for water production?

A. I would guess so, yes.

Q. Do you know whether you did or not?

A. From the pumper's reports? I suspect that we sent -- I don't know.

Q. Okay. Well, as a contract operator or pumper in this area for a coal gas well, wouldn't it behoove you to use the well report form that included a column for water production on a coal gas well?

A. Yes.

Q. Okay. And you just don't know at this point whether you did or didn't, which of the well-report forms that you have, that you used?

A. Yeah, I don't -- Because I don't have them anymore, I can't say with certainty. I'd like to think you're right, that I'm a good enough operator that we would keep track of the water production, but the fact that we didn't report it on the typed one and we didn't keep the handwritten one, I can't say with certainty that we were. You know, I didn't graph it out, I didn't keep any -- the data, so I can't tell you.

Q. Okay. Well, do you still have copies of the well-report forms for the coal gas wells that you submitted to Edwards for this period of January, 1995?

A. You know, my problem is, I have a whole folder of different well-report forms. Without seeing one from that time period, I'm not sure that I could tell you exactly which one we used. And that's what I was going to send you, was just my whole folder of different --

Q. Okay.

A. -- well-report forms, and I can't tell you which one was the version *du jour*.

Q. Okay. Well, I would also request that you furnish to us and to the Commission, so that we have it in the record, a representative well-report form for these coal gas wells during the period of 1995 to 1998, if you would.

A. Okay.

Q. Was there a point in time in 1998 when you recall changing the well-report form that you used for the coal gas wells that you were servicing for Pendragon?

A. Well, it became obvious, I guess, after our meetings that we were not reporting the water, you know. And why not? And we went through and discovered that, cripe, we're measuring the water, why don't we just report it? Discovered that the form we're sending to Pendragon doesn't have even a water column on it, and that's why they're not reporting it.

So, well, can we go back to just sending you our pumper's reports and skipping out the typing stage? And that was satisfactory with them, so that's what we started doing.

Q. Okay, and on the pumper report forms, would you also assume that you did not retain any of the pumper report forms for the coal gas wells, like you didn't retain the actual pumper report forms for the --

A. If we had typed -- you know, typed up and sent those on, we don't have any pumper handwritten copies.

Q. Okay. I hand you what I've marked as Exhibit W-40, another set of C-115 forms for Pendragon. And again, if you would -- The very first page of that form, which is dated -- That's the report for July of 1996; is that correct?

A. It says September 19th. Where do you look? Oh, I see, okay. Yes, July, 1996.

Q. And again, for the Basin-Fruitland Coal Gas wells there's no water reported on that form; is that correct?

A. That's correct.

Q. And then I'm not going to belabor this, but if you will look at -- toward the very back of this Exhibit A-12, and I'm in the section on the Chaco 5 well -- No, no, the A-12, the exhibit that's in the notebook there.

A. Okay.

Q. It's the very last section.

A. Chaco 5?

Q. The Chaco 5, yeah. And if you'll go to October of 1996 on that, and if you turn to the very last page of Exhibit W-40 --

A. Okay.

Q. Okay, do you see the well-report form?

A. Yes.

Q. All right. And just so that we're clear on all of the Chaco wells that are at issue in this Application, you would have used the same well-report form for the period 1995 through February of 1998 that did not include a column for water production; is that correct?

A. I can't say that. I don't know.

Q. All right. Well, let's look at this one for the Chaco 5.

A. Okay.

Q. Which form is that?

A. I can't tell you. You know, this is a typed copy.

Q. Well, but I mean which well-report form is this? Is this the well-report form that has the column for water production or that doesn't?

A. It looks like it doesn't.

Q. Okay, if you look at -- let's see, October 10th --

A. Okay.

Q. -- there's a reference to H_2O, 12 barrels per day. Do you see that?

A. Yes.

Q. Okay, and then another reference toward the end of the month, on the 29th, at 21 barrels per day?

A. Yes.

Q. Okay, let me just ask you the question that I asked you on the Chaco well. If this well in October of 1996 was producing these quantities of gas -- and that's a pretty good quantity, isn't it?

A. Yes.

Q. -- and it was -- it reported water on October 10th and then again on October 29th, given your experience, would you expect that well to have been producing similar amounts of water during the days in between those two reports of water production?

A. Yeah, I'd say 12 barrels a day down until the 28th, except for the one day where it looks like it was shut in, two days it was shut in.

Q. Yeah, you wouldn't expect any water production when it's shut in?

A. Right.

Q. Okay. And if you just taken an average of 12 barrels of water per day for the month, then you're looking at about 360 barrels for the month; is that correct?

A. That's correct.

Q. Okay. And if you turn to the last page of Exhibit W-40, it's the exhibit I just handed you that starts out in July of 1996 and goes through October of 1996 --

A. Okay.

Q. -- have you got the last page there?

A. Yes.

Q. Do you see the Chaco 5 well?

A. No water.

Q. No water reported; is that correct?

A. That's correct.

Q. All right.

A. That's what I thought I said in my five minutes, and your 30 minutes was that if I don't tell them what the water is, they're not going to report it.

Q. Now, let me just go over one more exhibit with you, if I can. This is Exhibit -- just for the record, W-10. It's the C-115 for February of 1998. It's already been admitted in the first-page form, but -- and I'll let Mr. Hall know and give you a copy so you know what I'm talking about, because I modified it in one respect, and so let me give Mr. Hall an opportunity to be made aware of that.

I realized as you look at the first page of that, that our exhibit label blocks out the water -- the production volumes for the Chaco 1. So what I did on the second page of that Exhibit W-10 is, I simply peeled off the exhibit label on the original copy so that you can actually see the barrels-of-oil-condensate and barrels-of-water-produced figures that are on there. Otherwise, it's the same document, but I wanted to make sure that you had a copy where you could actually see the volumes that were recorded down there.

MR. CONDON: I believe it's already been admitted in its prior form, but I would just ask that you admit it with the correction so that you have a copy that actually has all the data that shows up on the page.

CHAIRMAN WROTENBERY: Why don't we call it

W-10-A? I think we --

MR. CONDON: The second page? Well, W-10 is the C-115 report --

CHAIRMAN WROTENBERY: Yes.

MR. CONDON: -- for February of 1998.

CHAIRMAN WROTENBERY: Uh-huh, just so we don't get confused about --

MR. CONDON: Well, I think we can just stipulate on the record that W-10 becomes a two-page document rather than a one-page document, with the second page deemed the same page as the first, with the label removed so you can see the volume production reports on the Chaco 1.

MR. HALL: Sure.

CHAIRMAN WROTENBERY: Any problem? Okay.

Q. (By Mr. Condon) All right. Do you see the first entry on that page, Mr. Thompson?

A. I didn't get a copy.

Q. Oh, I'm sorry. It would be kind of tough for you to see it, wouldn't it?

A. For the Lansdale?

Q. Correct. What is that -- What kind of a well is that designated as?

A. "WAW Fruitland Sand PC (Gas)".

Q. Okay. And did you provide that information to Pendragon?

A. No, I did not.

Q. All right, that was at a time when that well was open to the coal, was it not?

A. February of 1998, I believe that's correct.

MR. CONDON: I have no further questions.

CHAIRMAN WROTENBERY: Thank you.

Commissioners?

COMMISSIONER BAILEY: No.

COMMISSIONER LEE: (Shakes head)

MR. HALL: One question.

REDIRECT EXAMINATION

BY MR. HALL:

Q. Mr. Thompson, were you present for the testimony of Mr. O'Hare and Mr. Brown when they testified regarding Maralex's failure to report water production from their coal wells?

A. Prior to first delivery?

Q. Yes.

A. Yes.

MR. HALL: No further questions.

CHAIRMAN WROTENBERY: Did you want to introduce --

MR. CONDON: Yes, I would like to move the admission of W-40 and -41.

CHAIRMAN WROTENBERY: Any objection?

MR. HALL: No objection.

CHAIRMAN WROTENBERY: They're admitted.

Thank you, Mr. Thompson.

Next, Mr. Hall?

MR. HALL: At this time we'd call West Hahn to the stand, ask that he be sworn.

WEST HAHN,

the witness herein, after having been first duly sworn upon his oath, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. HALL:

Q. For the record, state your name, please, sir.

A. West Hahn.

Q. And Mr. Hahn, where do you live?

CHAIRMAN WROTENBERY: I'm sorry, could you spell your name as well?

THE WITNESS: West or Hahn?

CHAIRMAN WROTENBERY: I've got West, but --

THE WITNESS: H-a-h-n.

CHAIRMAN WROTENBERY: H-a-h-n, thank you.

Q. (By Mr. Hall) Where do you live, Mr. Hahn?

A. Flora Vista, New Mexico.

Q. And how are you employed?

A. Walsh Engineering.

Q. In what capacity?

A. Lease operator/production foreman.

Q. All right. How long have you worked for Walsh?

A. Since 1994.

Q. All right, Mr. Hahn, are you familiar with the Chaco wells that have been the subject of this proceeding?

A. Yes, I am, I was Paul's first hiree and the first lease operator he had in that entire area.

Q. Okay. Are you familiar with the condition of the pits for the Chaco well when those wells were acquired by Edwards and Pendragon?

MR. CONDON: I'm sorry, could we -- before I forget, could we -- Mr. Thompson, you've got the exhibits that we went over with you? I'd just like to leave them up there for the other witness's pumpers, if I could.

MR. THOMPSON: Just the two? Three? Two?

MR. CONDON: The three, if you would, please. There's W-40, W-41 and W-10.

CHAIRMAN WROTENBERY: Okay, proceed.

MR. CONDON: Sorry.

Q. (By Mr. Hall) Where was I? Let's see, are you familiar with the condition of the pits for the Chaco well when they were first acquired by Edwards and Pendragon in 1995?

A. Yes.

Q. Could you describe the pit conditions?

A. Chaco 1 pit condition, approximately two feet deep, eight by eight.

Chaco 2-R -- or is it 2-J, which one? 2-R, 2-R. A foot and a half deep, eight by eight.

The 4 and the 5 pits at that time were -- until we did the workovers, were basically nonexistent.

Q. All right. Did you perform some work to get the pits?

A. Yes, we did.

Q. There has been some testimony by Mr. O'Hare that each time he observed the pits on the Chaco wells that they were full of water.

MR. CONDON: I'm going to object. I think that mischaracterizes his testimony, but that's for the record.

MR. HALL: Well, I think his written testimony speaks for itself, so...

MR. CONDON: I think all the testimony speaks for itself.

COMMISSIONER LEE: Do you guys want to go outside?

(Laughter)

CHAIRMAN WROTENBERY: The objection has been made for the record. Go ahead.

Q. (By Mr. Hall) I'm interested to know what your observations of the Chaco pits were during the period of time when you were out on the field at those locations.

A. Chaco 1 and 2-R, basically the same condition, full of blow sand. The previous operator did nothing to update the pits before we -- there was nothing -- They were a slope pit. One was deeper than the other. Again, the 4 and the 5, they were basically nonexistent until we did do our re-stim work.

Q. All right. How frequently did you go out to these locations, would you say?

A. When I was lease operator, every day.

Q. I see. Did you ever observe any of the pits at the Chaco wells being full of water?

A. The 4 and 5, no way. 1 and 2, with such limited capacity, not overrunning but had water in them.

Q. All right. Following the conduct of the fracture-stimulation treatments on the wells, would the pits have water in them then?

A. Yes, definitely.

Q. Other than those times, did you ever see substantial volumes of water in the pits?

A. No, workover -- after any workover performed out there, of course, there wasn't made -- our kill water back, that we put into the well, and that would be substantial for a short period of time, 30 days, 45 days.

Q. I see. It would take that --

A. Yes.

Q. -- long a time for the wells to unload the water --

A. Yes.

Q. -- from the rework?

A. Yes, there was no artificial lift, pumping units or anything on these to assist them or anything.

Q. So were you pumping well into the water -- pumping water into the wells, for the workover operation?

A. Yes, we were.

Q. Were any of the Chaco wells ever on pump?

A. No.

Q. Are you familiar with the line pressures in the area of the Chaco leases?

A. Yes, I am.

Q. What effect did those line pressures have on production in that area?

A. Dramatic.

Q. What do you mean by "dramatic"? Favorably or unfavorably?

A. Unfavorably.

Q. You have -- In the course of your work, you've had occasion to observe production of water from coal wells, I take it?

A. Yes.

Q. Generally, from your observations, how would the production of water from these Chaco wells compare to water production from a coal well?

A. Coal wells always have -- make more water, as a whole.

Q. All right. From your observations, did it look to you like these Chaco wells were producing like a coal well?

A. No.

MR. CONDON: I'll object to that question. I think that's calling for expert opinion.

MR. HALL: I asked for observations, from experience.

CHAIRMAN WROTENBERY: Overruled.

MR. CONDON: Okay.

Q. (By Mr. Hall) And the answer was --

A. -- no.

Q. Let me ask you about the Chaco 2-R. Have you ever seen black water in the pit for that well?

A. No --

MR. CONDON: I'm sorry, I'm going to object to that. That's way beyond the scope of anything that came out in our response testimony. Nobody ever said anything about black water except -- in the 2-R, except in the Lansdale Federal. I don't know where -- This is a new matter, totally new.

CHAIRMAN WROTENBERY: Did you say the 2-R?

MR. HALL: 2-R.

MR. CONDON: I mean, this could have been brought out on their direct case.

MR. HALL: I believe -- I thought there was some testimony from the Maralex witnesses about the 2-R. Perhaps I'm mistaken.

MR. CONDON: No, I mean, we'll stipulate that we didn't --

CHAIRMAN WROTENBERY: -- testify about black water in the 2-R.

MR. CONDON: -- testify about black water in the 2-R.

CHAIRMAN WROTENBERY: Okay.

MR. HALL: Well, that's fine. That concludes my questioning with Mr. Hahn. Pass the witness.

MR. CONDON: I don't have any questions.

MR. HALL: Okay, thank you, Mr. Hahn. Oh, I'm sorry, maybe the Commissioners --

CHAIRMAN WROTENBERY: Hold up.

MR. HALL: -- might have some questions.

CHAIRMAN WROTENBERY: Do you have any questions?

COMMISSIONER BAILEY: No.

COMMISSIONER LEE: (Shakes head)

CHAIRMAN WROTENBERY: Thank you, Mr. Hahn.

MR. HALL: Thank you, Wes.

At this time we would call Mike Wagner to the stand and ask that he be sworn.

MICHAEL WAGNER,

the witness herein, after having been first duly sworn upon his oath, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. HALL:

Q. For the record, sir, please state your name.
A. Michael Wagner.
Q. And Mr. Wagner, where do you live?
A. Aztec, New Mexico.
Q. Who do you work for?
A. Walsh Engineering.
Q. And what do you do for Walsh?
A. I'm a lease operator.
Q. How long have you worked for Walsh?
A. Since January of 1997.
Q. Okay. Are you familiar with the Chaco wells that we've been talking about in this proceeding?
A. Yes, I am.
Q. From the period you started working with Walsh in January of 1997, had you been out on the locations for the Chaco wells?

A. Yes, I have.

Q. How frequently?

A. Every Monday through Friday.

Q. All right --

MR. CONDON: Madame Chairman, at this point I'm anticipating where this is going. We've had Mr. Thompson and Mr. Hahn now, who have both testified about their observation of the Chaco wells during the period in question. I don't know why we need a third witness to essentially testify to the same matter. I mean, they've had an opportunity on rebuttal, two witnesses. I don't know why we need more testimony on it.

MR. HALL: Well --

CHAIRMAN WROTENBERY: Mr. Hall, where are you going?

MR. HALL: The reason is, we want to make sure we cover the entire period of time in question that Whiting and Maralex had questioned with respect to the observations of water in pits, et cetera. Not all three of the witnesses were able to observe the pits simultaneously, so with all of their evidence we cover that entire span of time, that's why.

CHAIRMAN WROTENBERY: Go ahead.

Q. (By Mr. Hall) Let's see if I can recall the last question. You said you were out on locations daily --

A. Yes, sir.

Q. -- the Chaco wells?

A. Yes, sir, five days a week.

Q. All right. And that's the period from 1997 to today?

A. To present.

Q. For that period, what were your observations with respect to water in the pits for the Chaco wells?

A. What do you mean by my observations?

Q. Did you ever see any of the pits for the Chaco wells full with water?

A. I've seen the one at the Chaco 1 full, right after we moved the rig off working on it.

Q. So -- And that was subsequent to a workover?

A. Yeah. Yeah, they come and they had to kill the well to work on it. Let's see, they had a joint partially unscrewed, and they had to pull that and repair it.

Q. I see. And in order to kill the well, did they have to inject water into it?

A. Yes, they did.

Q. And how long did it take for that well to unload that water?

A. I don't recall the exact time period, but it takes a little bit of time to get it all back.

Q. A number of days?

A. Yes.

Q. Other than that one example you've cited, did you ever see the pits full of water?

A. Not full. When we first put a compressor on the Chaco wells we did see an increase in water, and then it decreased back.

Q. All right. Have you ever observed any coal fines in any of the pits for the Chaco wells?

A. No, I haven't.

Q. Let me show you what was previously introduced as Whiting Exhibit N-7-A-3. Can you -- It's a photograph. Can you identify what's on those photographs?

A. That would be the Chaco Plant 5. They have a compressor. It sits out in the middle of a cornfield.

Q. Is this one of the wells that you service daily?

A. Currently, I do not.

Q. But --

A. Up until April I did. I did take care of this one up until April 1st.

Q. All right. And you had taken care of that well prior to that as well?

A. Yes.

Q. Are you familiar with the NAPI sprinkler system around that well?

A. Yes, I am.

Q. About this time of year in August, how frequently does that sprinkler system orbit the field?

A. Normally almost daily.

Q. All right. How fast would you say that sprinkler moves?

A. It crawls its way around the field very slow. It soaks everything bad.

Q. How long does it take the sprinkler to make a complete circuit, would you say?

A. Boy, I don't know the time period. It's slow, though.

Q. Is it safe to say a number of hours?

A. Oh, yes, quite a number of hours.

Q. And it discharges water in the exact location of the Chaco 5 well?

A. It goes right over -- That irrigation line goes right over the top of the well and compressor, the pit, well house, all of it.

Q. All right.

A. Goes right over the top of it.

Q. Do you see -- Let me ask you, is there a separator on the well?

A. Yes, there is.

Q. Does that separator discharge constantly?

A. No.

Q. How does that work?

A. It has a gas-operated valve on it, when the float operates it.

Q. Does that operate automatically?

A. Yes.

Q. So does it --

A. So when enough water gets in the separator it kicks and opens the dump and dumps it.

Q. All right. Can the water dump also be operated manually?

A. Yes, it can.

Q. So if you look at the photograph in the bottom right-hand corner, it shows tubing with a trickle of water there. Do you see that?

A. Yes, I do.

Q. Does that trickle run 24 hours, or only when the separator dumps?

A. Just when the separator dumps.

Q. Were you involved in the arrangement with the Maralex pumpers where you would meet daily and collect pressure data from the Maralex and the Pendragon wells?

A. Yes.

Q. And how long have you been doing that?

A. Since June of 1998.

Q. Tell us what's involved there. What's the schedule for that?

A. We meet at the 1 Number 1 every morning at 8:30.

Q. 8:30?

A. At 8:30, and we proceed through the five Maralex wells and the six Pendragon wells, recording pressures and volumes.

Q. All right. So if you started your run at the Chaco 1 well at 8:30 in the morning --

A. Not the Chaco 1, we meet at the Maralex 26-13-1 Number 1.

Q. I see, at 8:30, I understand.

A. At 8:30 in the morning.

Q. In July of this year, or even August of this year, did you ever see any evidence that Whiting or Maralex was conducting injection falloff tests on the wells?

A. I didn't see any evidence of the gas being moved. I did see they had a rig on the hole, they pulled the rods out of the hole, and they rigged up a slickline on it, and Matt told me they was running pressure bombs.

Q. I see. Did they ever tell you in advance and invite you to that test?

A. No, they did not.

Q. Have you met Mickey O'Hare?

A. Yes, one time.

Q. All right.

A. It was right in about that time.

Q. Did you have a conversation with him, ever?

A. No.

Q. Just enough to meet --

A. Matt introduced him, and we went on our way.

Q. In about September of 1998, when you were touring the Whiting wells with the Maralex pumpers, did you ever observe any changes to their lines out there?

A. Yes, I did.

Q. What did you see?

A. The lines on the 1-1 and the 1-2, they looped the lines so it increased the amount of volume they could get from the wellhead to the compressor. They also manifolded the casing, changed the valves on the casing to a bigger valve, full opening.

Q. All right. So those two wells you've identified, they were on compressor assist at that time?

A. They had a compressor there, but they weren't operating it at the time. I don't recall exactly off the top of my head what the problem was, but they were just in the process of setting up compression down there. They hadn't been compressing the wells prior to the shut-in.

Q. And have you seen that compressor operate since then?

A. Yes. They have two compressors there now.

MR. HALL: I see. Pass the witness.

CROSS-EXAMINATION

BY MR. CONDON:

Q. Just a couple questions. Mr. Wagner, were you involved in the work to dig out the Chaco well pits?

A. No, I wasn't.

Q. Let me just ask you -- I'm going to hand you what's been previously marked as AMO-8 -- they're a series of pictures of the Chaco pits -- and ask you to just take a quick look at those. And my question is going to be, do the pictures represent the current size and general condition of those Chaco well pits?

A. I haven't seen them look like this since I've been there, that I can recall. This is which one?

Q. I think it's marked at the bottom of the page as the Chaco 1.

A. Okay, Chaco 1. I know we had to dig this one out.

Q. And what is the current size of that pit?

A. Probably roughly about the same size, it still has the same fins on it.

Q. About what -- Can you give us the dimensions?

A. Probably roughly eight by eight --

Q. And how deep?

A. -- nine by nine, something like that.

Q. And how deep?

A. Probably three, three and a half feet.

Q. Are all of the Chaco well pits currently about that size?

A. Roughly. They change real often. The wind blows and the sand moves up there, and so they fill in constantly. We have to come in and clean them out.

Q. You talked about, I think, water being produced from the Chaco wells at about the time that workovers are done on the wells --

A. Uh-huh.

Q. -- is that correct? Let me hand you what's been marked as Exhibit A-12, and I'm in the very first packet on the Chaco 1 well, April of 1998. Are you the person who's responsible for preparing those well-report forms?

A. Yeah, I make this one, yes.

Q. Is that your handwriting?

A. Yes.

Q. Okay. And during April of 1998, there are four notations of water production on the well, one of 29 barrels per day. Do you see that one?

A. Yes.

Q. 35 barrels a day --

A. Yes.

Q. -- do you see that one?

24 barrels a day?

A. Yes.

Q. And 24 barrels a day?

A. Yes.

Q. Was there work done on the Chaco-1 well in April, 1998? Workover-type work?

A. Not in April.

Q. Okay. So that was a month when the well --

A. We --

Q. I'm sorry, go ahead.

A. We also just -- We had a compressor on here running, and I don't recall exactly -- I mean, just by looking at that, that doesn't tell me what time I started running the compressor, but I can also see my volumes are coming up.

Q. Uh-huh.

A. So we're increasing, we're going to pull water.

Q. Right, I mean, as you're increasing the gas production, you're also going to get an increase in water production?

A. Yeah, somewhat.

Q. Right. And you heard Mr. Thompson's testimony earlier today, right? You were here to hear his testimony?

A. Yes.

Q. Okay. Would you expect, based on your experience, that even though there are only four days when water production is reported for April of 1998 for the Chaco 1 well, that in fact that well was probably producing similar volumes of water on a daily basis during that time, given the gas production?

A. Yeah, roughly. If the line pressure goes up, your water rate goes down.

Q. Okay.

A. Your gas rates do too.

Q. Okay. Now, which well was it that you were talking about where you had to go in and kill the well?

A. Chaco 1.

Q. Chaco 1. And how many barrels of water does it take to kill that well?

A. I don't know, I'm not the one that watches workovers and --

Q. Okay.

A. I'm just a pumper.

Q. Okay. That's a slimhole completion?

A. Yes, sir.

MR. CONDON: You know that? Okay.

That's all I have.

CHAIRMAN WROTENBERY: Questions?

COMMISSIONER BAILEY: No.

COMMISSIONER LEE: No.

CHAIRMAN WROTENBERY: Nothing else here.

MR. HALL: Thank you, Mr. Wagner.

CHAIRMAN WROTENBERY: Thank you, Mr. Wagner.

MR. HALL: At this time we would recall Mr. Al Nicol to the stand.

CHAIRMAN WROTENBERY: Mr. Nicol, you're still under oath.

MR. NICOL: Yes, ma'am.

ALAN B. NICOL,

the witness herein, having been previously duly sworn upon his oath, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. HALL:

Q. Mr. Nicol, you've previously been sworn, and you participated in the hearing and heard the testimonies of Mr. O'Hare, Dr. Ayers and Mr. Brown, presented by Whiting and Maralex, have you not?

A. Yes.

Q. Let's start with Mr. O'Hare's testimony. Do you have some matters you wish to address with respect to his testimony?

MR. GALLEGOS: Well, Madame Chairman, can we have a specific question? Because we don't know whether it's a proper subject of rebuttal or not. And when the attorney just says, do you have something to say, I think we should go on a question-and-answer basis, particularly because of what limitations should apply to proper rebuttal.

CHAIRMAN WROTENBERY: Please go ahead and ask the questions.

Q. (By Mr. Hall) Let's talk about the testimony Mr. O'Hare rendered with respect to his Exhibit AMO-13.

A. All right.

Q. Do you have that? Do you want to address that, please, sir?

A. I don't have a copy.

I didn't understand why Mr. O'Hare didn't honor the highest points on his pressure-versus-cumulative plot. I see no reason for doing a mathematical average of the points. If you have points falling off the curve, to me it says that the pressure wasn't built up long enough to stay on the curve, or something else is happening to the well.

So I find fault with the method of doing the -- having the computer, as he said, do a mathematical fit to the points.

Also, I believe we have some documentation of the fact that there were several other points available. I have to confess, I don't have those in front of me.

Q. Speaking of the *Dwight's* data?

A. Yes, sir.

Q. This was -- This chart was done on the Chaco

Plant 5, which we presented in -- at some length in my testimony about --

MR. GALLEGOS: Can you identify the exhibit?

THE WITNESS: AMO-13.

MR. GALLEGOS: Oh, I thought you were now pointing us to your --

THE WITNESS: No, I was still --

MR. GALLEGOS: All right.

THE WITNESS: -- holding up this one.

MR. GALLEGOS: You're still holding up that one. Okay.

THE WITNESS: This hasn't been identified as an exhibit.

Q. (By Mr. Hall) Why don't you explain what that is you're looking at there?

A. It's a printout of *Dwight's* data on the Chaco Plant 5 well, production data and what pressures were available in 1975 through 1979.

Q. And what does that data show?

A. It shows an initial point of 225 pounds wellhead shut-in, 231 bottomhole pressure, 239 BHP over Z, in December of 1975.

And let me see, I think probably he has used the surface pressures, so I'll read those. That was at zero cum, so that was the initial point.

In May of 1976, with a cum of 164 MCF, wellhead shut-in pressure 218 pounds.

Can you see that all right, or do I need to bring it closer?

CHAIRMAN WROTENBERY: It is a little hard to see here.

MR. HALL: I'll be the easel.

CHAIRMAN WROTENBERY: Okay.

THE WITNESS: 218 pounds after 164 MCF. 174 pounds after 29 million cubic feet, roughly. And then in 1979, 174 pounds again, after not quite 50 million cubic feet.

MR. HALL: Everybody see it?

THE WITNESS: The whole point of this is that if you use the highest available pressures you probably are getting closer to an accurate P/Z or pressure-cum plot.

But if you have problems with pressures not falling on the line because they haven't been -- the well hasn't been shut in long enough, or it's loaded up, then you really don't know which ones are good and which aren't. It's an assumption even to say the highest ones are necessarily accurate, unless you have a large volume of them that are falling on that line.

Q. (By Mr. Hall) Now, let me hand you what was -- Are you finished with respect to that?

A. I am with that. Do you need to mark this?

MR. HALL: Well, that's a question. What you've been referring to, for the record, is the *Dwight's Energydata* production information for the Chaco Plant 5. It's a form of information that's -- I think the Commission can take administrative notice of, is the quickest way to handle this. Or, we can --

MR. GALLEGOS: Well, maybe we can --

MR. HALL: -- provide you with copies.

MR. GALLEGOS: Maybe we could just have a quick look at it, Mr. Hall.

MR. HALL: Sure, you bet.

MR. GALLEGOS: I don't insist on it being an exhibit, just so we could look at it.

MR. HALL: We'll be glad to supplement the record with that, if you like.

CHAIRMAN WROTENBERY: Okay, yeah, let's go ahead and if it looks okay with you, let's mark it as an exhibit.

MR. HALL: Okay. We'll call that N, for Nicol, A, and I'll provide the Commission with some marked copies of that, and Counsel as well.

MR. GALLEGOS: What did you -- You've assigned it an exhibit --

MR. HALL: N-A.

CHAIRMAN WROTENBERY: Do you have any objection?

MR. GALLEGOS: Just N-A?

MR. HALL: Yes.

MR. GALLEGOS: No objection.

CHAIRMAN WROTENBERY: We'll admit that.

MR. HALL: I'll keep this so I can make copies.

Q. (By Mr. Hall) Let me hand you what was introduced yesterday or the day before. It's marked Exhibit AMO-12. Do you recall Mr. O'Hare's testimony with respect to that exhibit?

A. Yes.

Q. Why don't you identify that for the record?

A. This is a production plot on semi-log paper of the Chaco Plant 5 well, and it looks to me like it was done by our independent engineers for an engineering report dated 3-1-94, if I read the upper corner correctly, and it's basically their reconstruction of the production data as they understood it from that well.

And behind that was the hand-drawn production decline curve that I provided as part of my exhibit, which I'm trying to remember the number of it. Oh, it's N-7-A, I believe, and that was the first of several sheets in N-7-A.

Now, the Chaco Plant 5 is a tough well to evaluate, and I have provided all the information that I used and used in attempting to reconstruct a proper production decline curve for that well, simply because it's the kind of question where you may want to just resolve it for yourself.

The well early on was going through a common meter with the Cowsaround 21-1, and production was being allocated by the operator at the time, and I didn't think it was being properly allocated. My reading of the field reports, the same kinds of reports that have been discussed here for daily production that we've seen, indicated to me that it was a much stronger well earlier than was indicated by this curve, or by the production that was reported to the State.

But there was no attempt to hide information or to not disclose it. The last sheet on N-7-A is the production as it was recorded to the State, so that you would be able to compare what I had done on page 1 with the intervening sheets, which are the production decline curves of our other Chaco wells, and then here I disclosed what had actually been reported. And then in the subsequent portions of that N-7 series of exhibits we provided the backup data for my assumptions to create that hand-drawn plot.

Q. All right. Let me ask you about another area Mr. O'Hare discussed. He questioned the reliability of the tubing pressures for the Chaco 2-J. Would you care to rebut that?

A. Yes, the 2-J, which is -- by now you've got it memorized, it's the one closest to the Gallegos Federal 1-1 well, 180 feet away, is the one that's consistently shown the highest pressure in the Pictured Cliffs. It has shown pressures in the 190-pound range in May of 1998, long after the acid job in 1995. I think the pressures in 1995 were in the 188- to 198-pound range. There were several of them.

And the pressure in May of 1998 was a bottomhole pressure. We ran a bomb. And it went to bottom, there wasn't any restriction in the tubing. There is some water in the hole. And apparently that water was causing some problems with surface readings, and the tubing readings have been erratic.

But Mr. O'Hare threw out some speculation that because of some sort of plugging or problem between the tubing and the casing annulus, that you couldn't rely on the tubing readings.

I was concerned in May that because of the high reading -- May of 1998 -- that it might be showing us a leak in the casing or something. So we blew it down and checked for a leak or any indication that there was something wrong with it, and then ran another bomb in July of 1998. That one built in three days to 178 pounds and was still going up. This is in my testimony. If I recall, my Horner plot on that took it to an extrapolation of about 190. But after we shut it back in, after pulling the bomb, it built up again for several weeks. So it took a long time to build up.

The point here it's opened in the tubing, the tubing pressures are real, there's no reason to ignore them, and as far as we can tell it's a valid pressure in the PC.

Now, we ran another bomb in April of 1999. That one only got to 125 pounds.

Now, to do this, what we do is install a lubricator, which is basically a 30-foot jointed 2-7/8 tubing, on the top of the wellhead, and then put the bomb -- the wireline in it, pack it off at the top, open the bottom valve and let it drop down.

That lubricator by itself, in my calculation, accounts for something like 7 percent of the volume. So you immediately draw down the well about 7 percent to fill the lubricator.

We saw a lot more drop than that with the bottomhole pressure of 125, and I don't know why that was a drop, whether there was more gas lost in the process of installing the lubricator, opening valves or what. I have no idea. I talked to Mr. Tefteller, and he didn't know either.

But after we took that 125 pounds, the well built back up and has recently been showing 190 pounds surface tubing pressure again. And once again, we know at least in April that the tubing was clear all the way to the bottom, to the perfs, and the tubing readings should be valid.

Q. Now, Mr. O'Hare also testified about the effect of a possible casing leak in the Chaco 5. Why don't you address that?

A. That was discovered in January of 1995 when we began the process of trying to fracture the Chaco 5. And if I'm recalling the depths correctly, it was found to be somewhere above 972 feet.

What we did is just unscrew the casing, which is 2-7/8 tubing installed as casing, pull it out, put the good string in, and screw it back in and tested it. It held, the pressure held, so it was now repaired. And that was done in early February of 1995.

The leak was somewhere above that 972 feet. The cement job comes up to in the neighborhood of 1000 to 1020 or 1030 feet, depending on how you interpret the top of the cement bond log. And that is still 30, 40, 50 feet above the highest coal stringer that I can identify in that well as even a possible coal stringer.

So I don't think we were ever connected with the casing leak to the coals, and certainly not to the coal that's been perforated in the nearby wells. The only well that's had the upper coals perforated has been the 1-2 over here, and we're talking about the Chaco 5 here.

Now, yesterday there was some evidence presented of BTU values, or at least one BTU value in March of 1995, after that repair, that showed 1022 BTU, if I recall correctly. And then we frac'd the well in -- It was the 10th of May, 1995, and shortly thereafter got a pressure of about 151 pounds in the well.

That pressure has also been blamed on the leak, but with the kinds of permeabilities we've talked about here and have seen in cores and all the other discussions, if that leak had been repaired for three months and we had that kind of permeability, the well should have been able to bleed off.

Since this was a pressure after the frac job, there's no excuse for it having been pressure that was left because of damage that we were trying to repair. This is an after-frac-job pressure.

Q. During his testimony, Mr. O'Hare made some conclusory statements that in his opinion some of the Chaco wells were producing coal gas. Did he take into account the slimhole completions on the Chaco wells, in your view?

A. Well, he's certainly aware of them. I guess I don't know how to answer.

Q. What bearing does that have on the opinion rendered that these Chaco wells, in his opinion, were producing coal gas when you have slimhole completions on them, and bearing in mind the water that's typically produced by coal wells?

A. Well, if I understand your question, the premise that's been presented is that we can somehow lift the water and produce coal wells without having to do artificial lifting or without having to dewater. And it wasn't just our Chaco wells, but the Chaco Plant 5, for example, was done in 1992.

And at that time in my testimony, I presented the history of the few other coal wells that were in the general neighborhood of that well, in all directions, and the volumes of gas that they had produced at that time. None of them reported water, all of them had to be making water, and probably a lot of water because they were very early on in the dewatering process.

But by -- and if I said 1992 -- I'm trying to remember whether it was 1992 or 1993. I guess it was 1993, pardon me. By the time the Chaco Plant 5 was making the kinds of volumes you see on my N-7-A report, it was producing more gas every two months than any of those other coal wells, adding cumulative production to that point.

So they were very early on dewatered, and in dewatering, it could not possibly have dewatered the Chaco Plant 5. So it was acting like a Pictured Cliffs well, a standard Pictured Cliffs reservoir producer. It was not having to lift a lot of water, and it was not on artificial lift. It was not pumping like the surrounding coal wells were.

The similar problem occurs in the testimony -- and this may have been Mr. Brown, if I may skip to that, on the Designated Hitter well, concerning the BTU values in that well and why they think it's a coal well also.

That well was completed, if I recall, in 1980. It's in N-37-D of my exhibits, and there's a table on that well by itself, as well as being included in all the N-37 series of exhibits. It was not acidized and not frac'd, to my knowledge -- and I say "to my knowledge" about the acid; I'm positive it wasn't frac'd -- until 1994, and yet BTU values dropped after the first reading of about 1111, if I recall, down to the middle 10,000 [*sic*] range, and sometimes as low as 1018, and bounced around a little bit.

And there is no reason to think that that well also was a Pictured -- or I mean a Fruitland Coal well, because it again was flowing, it was not on artificial lift, it had not been acidized and had not been frac'd.

Q. Mr. Nicol, in your opinion were Mr. O'Hare's conclusions with respect to the possibility that there was crossflow between zones correct?

A. No.

Q. And why not?

A. That's -- I've covered that in a lot of detail in my testimony. In the interest of time, I think I would defer that. I think Mr. Cox is going to cover some of the same thing.

Q. All right.

A. But I could on for an hour on drawing diagrams and following the logic, but we have pursued that logic in detail, in depth, in the testimony.

Q. All right, let's move on to Dr. Ayers' testimony on the geology. He offered testimony with respect to whether the Chaco wells are completed in the appropriate common source of supply. Do you care to rebut what his conclusions were with respect to that?

A. There were a number of comments about the common source of supply and the definition of the pools, and there is a lot of confusion about the definition of the pool versus why we're concerned about Pictured Cliffs versus Fruitland sand.

Q. And for the record, you're referring now to your Exhibit N-3, which is your A -- I'm sorry, exhibit --

A. I put up N-63, which is my cross-section C-C'.

Q. Thank you, go ahead.

A. The purpose of this cross-section was to show our understanding of the use of the definition of equivalent stratigraphic, or stratigraphic equivalent, to determine which pool we're in.

This is the definition well, Schneider Gas Com B Number 1, in Section 28 of 32 North, 10 West, which is roughly 35 miles from the area we're talking about around the Chaco wells.

Now, as I understand the language, it states that all coals above the stratigraphic equivalent of this point right here, 2880 feet, and below the stratigraphic equivalent of 2440 feet, will be included in the Fruitland Coal Pool. Now --

MR. GALLEGOS: Excuse my interruption, Mr. Nicol, but Madame Chairman, this is just the direct all over again. This is just a rehash. There's nothing different here. Pendragon knew Dr. Ayers' testimony, they'd heard it twice before. Mr. Nicol addressed it in his direct before, and all we're doing is just going back over it again. It is not proper rebuttal.

MR. HALL: Mr. Nicol's answer is in direct response to the questions with respect to Dr. Ayers' testimony. I think he ought to be allowed to testify.

MR. GALLEGOS: Well, because you've asked the question doesn't make it proper rebuttal. It's just a rehash of his prior testimony. We've been through all of this, we know what his position is, or Dr. Ayers. We don't need to go back over it another time.

MR. HALL: He's going to address Dr. Ayers' testimony. I suggest we let him proceed.

THE WITNESS: I do have some points on this I would like to --

CHAIRMAN WROTENBERY: Yeah, we did, I think, go into some additional detail in Dr. Ayers' testimony that wasn't in the prefiled testimony, so we'll go ahead here.

Q. (By Mr. Hall) Go ahead, Mr. Nicol.

A. First of all, Dr. Ayers referred to a small sand between the two coals and just below the thicker of the two coals, right up in here.

Q. Which well is that you're referring to?

A. That's the Schneider B Com Number 1. And his comment was that that is stratigraphically equivalent to what he is calling the WAW sand and I'm calling the upper Pictured Cliffs sand, and I'm having a little trouble with that.

May I borrow that section of log? I'll borrow that too. Can I borrow this?

MR. GALLEGOS: Oh, okay.

THE WITNESS: What Dr. Ayers was referring to --

Q. (By Mr. Hall) And for the record, you're referring now to WA-4 type log?

A. Yes. He has colored in as a little yellow sand, just below the thick coal, right down here, and on the density log it is very tight, probably down in the 6- or 7-percent porosity range. And on the gamma-ray log it's still looking like primarily shale.

On the induction and spontaneous potential log on my exhibit, it shows no resistivity indicative of a reservoir sand or clean sand, and no SP response at all in that zone, and it is at best a foot or two thick. I don't think that's a sand to be discussing as stratigraphically equivalent to --

MR. GALLEGOS: And I object, because that wasn't Dr. Ayers' testimony. The stratigraphically equivalent was the bottom coal, was what he referred to.

THE WITNESS: No, sir, he said specifically that that sand was stratigraphically equivalent.

Q. (By Mr. Hall) Go ahead, Mr. Nicol.

A. Anyway, it doesn't show up on offset wells, it doesn't show up in the other well in that section, which is right here, and it is not stratigraphically equivalent to the top of the Pictured Cliffs, which is what's pictured, and, as most of my cross-sections show, ties into the top of the Pictured Cliffs as it becomes the upper Pictured Cliffs sand over the area we're talking about, this being the Gallegos Federal 6-2 well.S

Now, he also answered a couple of questions from the Commissioners, and I'd like to provide some answers to that if that's permissible.

Q. Go ahead, which questions are you referring to?

A. One of the questions was concerning the possibility of gas coming from the coal and the source of gas being from the coal as well as from the Lewis shale, going into the Pictured Cliffs.

In this log, which is in Section 1 of 27 North, 12 West, downdip to our stratigraphic traps in the WAW-PC Pool, here's an example of the basal Fruitland Coal sitting right on top of the Pictured Cliffs with no separation between them.

Now, for the coal to be the container for the kinds of thermogenic gas it has, it had to have been a lot deeper at some time. It's a mature coal from the standpoint of generating gas. And as it uplifted, the pressure would have dropped and some of the gas would have come out of -- been desorbed and become movable as pressure dropped and the Basin were uplifted. It's likely that it went in different directions out of the coal and dissipated into other parts of the Basin, into outcrops.

But it could just easily have come down into the Pictured Cliffs. And you could have mixing from the gas from the coal into the Pictured Cliffs in this situation. And as I say, that's downdip. If you tilted the structures like this, then that could be gas mixing with Pictured Cliffs gas, either thorough mixing or in pods and pockets and streams and stringers of gas, I don't know. But the geologist in me says that that's probably something that has happened.

Q. Was there another question that the Commissioners raised you wished to address, in response to?

A. Probably not, since I've forgotten it.

Q. Okay, that happens.

Let's -- Yesterday Dr. Ayers testified about some of his correlations on his WA-3. Why don't you discuss what he testified to?

A. This cross-section has come and gone, I don't know how many times, in the last couple weeks, and I'm very interested in addressing this.

First of all, as we pointed out yesterday, that Dr. Ayers, in the Gallegos Federal 7-1 well, had picked the top of the PC as 1170 feet, and that his client had picked it 1160 feet on their completion reports.

In this case, I agree with the client, even though Dr. Ayers shows sand up here. There is no sand here, and I'll come back to that. But there is sand in this interval right here that Dr. Ayers left as a shale.

Spontaneous potential, resistivity, gamma-ray and density logs all show this to be a sand right here, and I don't think there can be any question about it when you look at it in detail.

A ramification of that is that it puts this bump in the correlations here back to where it ought to be, but it moves one or both of these coals down into the Pictured Cliffs. I don't know how he would be able to re-correlate it to handle that, or even if he would. But the fact is that one or both of these coals are, in fact, in the Pictured Cliffs formation.

Now, the other problem I have with this log and the one next to it, which is the 2-R, is that there is no sand there. This is a shaly interval. There is no SP development in the sand where he's got it marked in yellow. The gamma ray is shale, it's comparable to the gamma ray above the coal and up on through the Fruitland section. And the density log shows it to be denser than the porous sands below. So that also is a shale. The sand does not exist here, and there's no sand in our 2-R well in that section.

And you see it better on my cross-section A-A', which is N- --

Q. That's N-3.

A. N-3.

Q. I'm sorry, N-4.

A. In his written testimony, Dr. Ayers also refers to a pick in the Chaco 2 well as being opportunistic and --

MR. GALLEGOS: We object. They've had weeks to respond to that testimony. This is nothing new.

THE WITNESS: It is new, we got it at the same time you got ours. How was I going to respond to it then?

MR. GALLEGOS: Well, because you testified here for a day and a half, and you had an opportunity, and you didn't testify in response to what we had prefiled, just as we did to yours.

MR. HALL: Let's not argue with Mr. Nicol. There was some testimony yesterday with respect to my questions to Dr. Ayers about opportunistic picks that the other operators had used for the Pictured Cliffs sand, so I think it's proper.

MR. GALLEGOS: Well, we object.

CHAIRMAN WROTENBERY: Please proceed.

THE WITNESS: That Chaco 2 well is on my -- I think it's Exhibit N-58. It's cross-section F-F', for reference.

And he points out that the operator in that well happened to pick the top of the Pictured Cliffs below what he calls the WAW sand, which I call the upper Pictured Cliffs sand.

There again, if you look at the logs there is no sand there; it's a shale. The problem I have, then, with his mapping is that if he continually picks zones that are shale and is calling them sand, then the discussion he has about what is spiky character versus cleaning upward character or coarsening upward character is invalid because he's not confining his comments to just the sand that I've mapped or the upper Pictured Cliffs sand. He's picking things that are basically all shale and not separating them.

Now, this cross-section has another value, and that goes to his Exhibit W-9, I believe, or WA-9. It's the unpublished spontaneous potential map that he mentions. And in that he shows that in the area we're talking about, the two-township area, 26 North, 12 and 13 West, that he has mapped the general drain of the Pictured Cliffs based upon spontaneous potential. And he shows on that exhibit the SP is 40 to 80 millivolts in this area.

Now, spontaneous potential is a measure of a little galvanic cell that's set up in the well between the drilling mud and the formation -- native formation fluid, if they are different enough to set up a little inductive cell. It's the same thing as touching a filling with a fork, and this tool just measured that.

If you have fresh water in the drilling fluid and salt water in the formation, you get a significant spontaneous potential response. And Dr. Ayers' testimony is that the Fruitland is laid down in fresh water, coastal-plain, floodplain environment, fluvial environment, and the Pictured Cliffs is laid down in a marine environment.

Well, his 40 to 80 millivolts conforms very well to the SP development of our upper Pictured Cliffs sand. We have about 60 millivolts in the Chaco 2-J, 55 millivolts was my measurement in the Chaco 5, and 50 to 60 in the Chaco 4, and so forth. That's the same readings you get down here in the Pictured Cliffs, and entirely different from the SP readings you get, or don't get, in what he's marked as sands throughout the Fruitland, where because it's fresher water you get virtually no SP response up here, as opposed to very dramatic SP response in the upper Pictured Cliffs sand.

So that is marine sand, laid down in marine water and salt water. These are laid down in much fresher water.

Q. (By Mr. Hall) Yesterday Dr. Ayers testified about his definition of Marine depositional environment. I believe he said -- Well, let me ask you. Is a lagoon marine?

A. Yes.

MR. GALLEGOS: Objection, that was all set forth in the prefiled testimony.

CHAIRMAN WROTENBERY: I don't recall it being there, because I remember thinking for the first time yesterday that he hadn't -- at least I hadn't picked up on it in his prefiled testimony in quite the same way that he presented it yesterday.

So please go ahead.

THE WITNESS: I believe Dr. Ayers also testified -- and let me ask for clarification if this is not correct -- that a marine sand is directly influenced by the action of the sea. Is that close enough to a quote?

MR. GALLEGOS: I think that's close enough.

THE WITNESS: Okay. What I said in my testimony was that it's tight and wave-dominated deposition.

I have provided some aerial photographs of the type of environment that I believe we're talking about here, and this particular one is the Texas Gulf Coast south of Corpus Christi. We're looking at about 7 miles on the side for the photograph, and this dark blue out here is open water in the Gulf of Mexico.

The white line here is the beach along Padre Island. This is Padre Island. This is the -- what you call the lagoonal area behind Padre Island. And this mess in here is the dredging for the Intercoastal Waterway, and we just have to put up with that.

There are additional bars developing back in here, and then the shoreline of this particular area is extremely ragged because it is controlled by the deposition of sand dunes blowing out into the water.

The sand -- First of all, Padre Island is basically all sand except for the vegetation. And the sand shows up as white on beaches, and light blue where the water is very shallow, and sometimes grades into deeper water. And in some cases you see where there's areas where it looks like deep water, but it's probably just deposition of organic material and mud mixing where the water is quiet enough that you have something besides just sand on the bottom, and that's going to become eventually shale.

This is called an island for a reason. That's not the shore. And the depictions we were seeing yesterday were using this beach basically as a shoreline. This is the shoreline, this is the edge of the ocean here. That's an island. It's a barrier island.

And most of the Pictured Cliffs deposition and description involves a barrier-island environment. But that also includes things like tidal deltas and washover fans and tidal channels and sheet sands like you see lying in here. And this is what I envision our upper Pictured Cliffs sand looking like, and it doesn't have to be 20 feet thick or 50 feet thick.

Now, Dr. Ayers talked about a washover fan as being a nonmarine deposition, but this is marine here. I mean, you've got porpoises swimming by and sand sharks, and if you park the boat here it's going to grow barnacles. And it's got tides and it's got waves.

And if you have a washover fan forming here because a storm or hurricane came up and washed the sand from this beach up over the island and back into this environment, as Dr. Whitehead commented last night, you could be darn sure that you were in a marine environment if you were standing out here while that was happening.

There were two such photos, but I won't take time to brief the other one.

I do want to follow up on another cross-section about that, if I may.

Q. (By Mr. Hall) Go ahead.

A. This is my cross-section J-J', which --

Q. It's Exhibit N-53.

A. N-53. And I'd like to address the well out here and refer to it on Dr. Ayers' isopach of the -- what he's calling the WAW sand.

May I borrow that? This is W-10.

Q. Why don't you identify the well, please, sir?

A. This is the El Paso Natural Gas Hanson Number 2 well, located in the northeast northwest of Section 36 of 27 North, 13 West. It's this well right here.

This is the induction electric log on the well, and you've got the basal Fruitland Coal in blue, what I'm calling for the purpose of my discussion -- I'll just differentiate it from the other shales, the under-clay. It's the shale immediately below the coal that is so consistent, laid down on the marine environment.

And then you go into sand. We've got about four feet of that shale or under-clay, and you've got some spikes here on the resistivity. But the conductivity is saying that there's no shale there, you don't have the kind of conductivity you have right here in the shale, or even this kind of conductivity above the coal in this shale right here.

And if you were standing there looking at this section of the outcrop, you would see coal, shale and sand from there on down. And you would call the top of the Pictured Cliffs right here. The operator called the top of the Pictured Cliffs right there.

Dr. Ayers has mapped a little over 11 feet of what he's calling crevasse splay, by preference, in that area, and that would put it in this interval here, basically an interval covered by my red arrow, a little bit less than that. It's from the top of the SP spike here to the top of the next one here, to the bottom of this SP spike, I should say.

So what he's got, then, is, if it's a crevasse splay, he's got one out in front of any lagoonal deposition and out in front of any floodplain deposition, sitting right on top of the rest of the Pictured Cliffs sand. And it's difficult to conceive how that would happen. It's hard to imagine how you're going to have a crevasse splay coming out farther out in the depositional sequence, since you could even have a river.

So I think this is the area that I show as being basically coalesced into all sand, and carry it back down as you start picking up some shales and little thin coals in the lagoonal environment, but still the upper Pictured Cliffs sand coalesces into that sand right here, and it's not a crevasse splay.

Q. All right, yesterday I believe Dr. Ayers used a term that's -- The first time I heard it used in these proceedings is yesterday when he talked about the sweet spot. Do you recall that?

A. Yes, sir.

Q. Would you refer to Exhibit N-3, please, sir?

A. N-3 was a structure map on top of the basal Fruitland Coal, the 20-foot coal, and there was some question about, is there anything going on with structure or whatever in the area that would create or enhance production by additional permeability?

And I mentioned in my testimony that there is slight nosing through the area of the Chaco 4 and 5, which are right in here, and it's the 1-12 well and the 6-2 well here, which could enhance permeability.

Q. Dr. Ayers also testified yesterday about the core analysis on the Lansdale and opined about that. Do you care to address that?

A. If you look at the Core Lab description of the sand on the Lansdale well, it's pretty uniform description top to bottom, and that was covered yesterday.

He also refers to a page out of a Halliburton report that was done on that well, and I guess I don't recall what the number was for that exhibit on his sheet.

MR. GALLEGOS: Madame Chairman, both of those things were in the written testimony, they were exhibits to the prefiled testimony, they were discussed in the prefiled testimony, nothing new about that, nothing different. Improper rebuttal.

MR. HALL: Well, I don't believe Dr. Ayers included the entire report in his exhibits, and that's what we're addressing now.

MR. GALLEGOS: Well, that's not rebuttal, that's something you could have done.

CHAIRMAN WROTENBERY: Well, let me make something clear here too, and this is my fault, perhaps, in administering the hearing, but at the outset we didn't make it clear, I don't think, to Mr. Hall that he needed to go ahead and do all of his rebuttal testimony to the prefiled testimony during his presentation of Pendragon's case. We started talking very early on talking about the fact that he would do rebuttal testimony. So I think that may be part of where some of this confusion is coming up, and I apologize for that.

But he did not take the time, for instance, that Mr. Gallegos or Mr. Condon took with each of his witnesses to address the testimony that had already been presented by the other party, and so I'm inclined to give him that opportunity here because of that uncertainty.

MR. HALL: Thank you.

Q. (By Mr. Hall) Let me refer you to the first page of that report. We've marked it as Exhibit Ayers-4. Go ahead, Mr. Nicol.

A. First of all, on the page that Dr. Ayers did present, there was a paragraph describing the sand in some detail, and that was described for the sample at depth of 1066 feet, and that's what Dr. Ayers used to say this can't be Pictured Cliffs sand, it's not the kind of description you'd expect for a deep sand.

I'd just like to point out that that description also includes the interval at 1071 feet -- this is the

Lansdale Federal -- 1071 feet and 1077 feet, both of them in the Pictured Cliffs. And all that Halliburton said about that is, it's the same as the sand above that they have described. So what you're getting is a uniform description for all three samples, including the two that are shown here to be in the Pictured Cliffs.

The first page of this report, which wasn't included in his exhibit, states, in the first paragraph:

> The Pictured Cliff formation samples from this well show considerable water sensitivity to both fresh water and potassium chloride treated water.

Then they go on to talk about how they stabilize that.

The second paragraph says:

> The samples are basically a fine to very fine grained kaolinite clay cemented sandstone. Permeabilities range from less than 1 millidarcy to 272 millidarcies. The main water sensitivity is kaolinite clay migration in the pores.

So there's some outside substantiation for a source of damage occurring as production occurs in these wells.

Q. Mr. Nicol, let's now turn to Exhibit JTB-4, which was discussed by Mr. Brown.

CHAIRMAN WROTENBERY: Mr. Hall, I'm thinking we need a break pretty soon. How much more do you --

MR. HALL: This will be just about to wrap up here.

CHAIRMAN WROTENBERY: Okay.

Q. (By Mr. Hall) Do you have Exhibit JTB-4 before you here?

A. I don't have it in front of me, but I can speak to it.

Q. This is the Chaco wells BTU plot. Mr. Brown rendered some testimony yesterday with respect to the response of BTU measurements, post-frac, in the Chaco wells. Do you care to respond to that?

A. The first thing that I would take note of is that his line which, as I understand it, is supposed to be when the wells were frac'd, the vertical dark line, is nearly a year late. It looks like it's marked in about December of 1995. The fracs took place in January and May of 1995.

And the second thing is that the -- on his chart the substantial changes in BTU for some of the wells don't occur until sometime after 12-27-96, or a considerable time after the wells were frac'd and began to produce.

MR. HALL: All right. That concludes our questioning of Mr. Nicol.

CHAIRMAN WROTENBERY: Okay. Why don't we take a break? How long do we want?

COMMISSIONER BAILEY: Twelve minutes.

CHAIRMAN WROTENBERY: Twelve minutes, till ten till four.

MR. HALL: A quick housekeeping matter. Let me move the admission of Exhibits N-A and Ayers-4.

CHAIRMAN WROTENBERY: Any objection?

MR. GALLEGOS: What is N-A?

MR. HALL: That's the *Dwight's* we'll provide you.

MR. GALLEGOS: No objection.

CHAIRMAN WROTENBERY: Those exhibits are admitted, and you're going to provide us copies of N-A?

MR. HALL: Yes, sure will.

(Thereupon, a recess was taken at 3:40 p.m.)

(The following proceedings had at 3:50 p.m.)

CHAIRMAN WROTENBERY: I think Mr. Nicol is ready for cross.

CROSS-EXAMINATION

BY MR. GALLEGOS:

Q. I wanted to make sure, Mr. Nicol, my ears don't deceive me. On this lab report on Ayers Number 4, you said this sentence, "The main water sensitivity is kaoline clay migration in the pores." And that's evidence of the damage that you folks have been contending existed in these wells?

A. What I said was, that is independent corroboration, or whatever word, that that sort of damage can occur.

Q. Kaolinite clay migration in the pores, that's a condition that exists in nature through the reservoir, throughout a reservoir, isn't that right, if it exists?

A. Not migration. You have to have moving water to do that.

Q. Okay, and that's something that's going to be overcome by fracture-stimulating a well? You don't contend that, do you?

A. Sure.

Q. All right.

A. You've got brush piling of fines up against pore spaces. I mean, that's the problem that they are addressing here, I think.

Q. Oh, okay. So something -- This clay migration is at the perforations in the wellbore?

A. I don't know how far back it goes. It depends on the velocity of the fluid that's carrying it and what velocity is needed to move the fines.

Q. Well, where is it then?

A. It's going to be worst close to the wellbore, and less of a problem the farther away you go. And there's no way to quantify that.

Q. And you say that the fracture-stimulation of a well is going to remove that as an impediment to production?

A. That's a way to get past it.

Q. Okay. And you have some samples of that being the case, where that condition exists and fracture-stimulation overcame the condition?

A. I can't provide any other examples at the moment.

Q. I also want to be sure that I'm hearing you correctly, that you're saying that this -- what you call the upper Pictured Cliffs sandstone that occurred at the Chaco wells, was laid down in the lagoon on the coast of this ancient sea that you --

A. Most likely in the lagoonal environment. I mean, it could be a sheet sand out on the other side of the barrier bar, but I would expect it to be thicker at the bar side that way, rather than thicker toward the ocean.

Q. Okay, laid down in a lagoonal environment, and you say that's a marine environment?

A. Yes, sir.

MR. GALLEGOS: Okay, that's all the questions I have.

CHAIRMAN WROTENBERY: Any questions?

COMMISSIONER BAILEY: No.

COMMISSIONER LEE: No.

CHAIRMAN WROTENBERY: Thank you. Thank you, Mr. Nicol.

MR. HALL: At this time, Madame Chairman, we'd recall Dave Cox.

CHAIRMAN WROTENBERY: You're still sworn.

MR. COX: I remember, thank you.

CHAIRMAN WROTENBERY: Okay.

DAVE O. COX,

the witness herein, having been previously duly sworn upon his oath, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. HALL:

Q. Mr. Cox, in the course of last night and today we've had some discussions with Mr. Robinson with respect to the injection falloff test. Do you have any concern regarding that test and Mr. Robinson's analysis of it?

A. Yes, I do. I have a number of concerns about the validity of that test because, to start with, the test data themselves have inconsistencies.

The producing times, I see at least two and perhaps three different clocks apparently were used. The bottomhole pressure bomb had one clock, the gauge at the surface had another, and then the reports that Maralex put together show yet a third different time. So for that first injection period, the downhole gauge shows 10.8

hours, the surface gauge shows about 13 hours, and the Maralex report says 12 hours.

Now, if I don't know the time, which is one of the easiest things to measure, it makes the test very questionable to me.

Secondly, though, the initial pressure at the time that the test was run was not used in the analysis. Now, that number was 70.15 p.s.i., if I remember, from Exhibit Robinson-B. And so the pressure differential which enters into that calculation of permeability, when they used 94.75 pounds for the initial or starting pressure, they're showing a pressure differential that's a half or a quarter of what the true pressure differential was during the test. What that does is, it means that the permeability that they're calculating is two to four times too high, because they've used a pressure difference that's too low.

Now, in addition, I don't know the conditions before the test. That well was producing the day before the test started. They apparently pulled the rods and somehow did a hookup to get gas into that well, but during that time what was happening with the well? The well had produced some. We know these wells take at least several days to build up. And in fact, at the time that they started the test, the pressure at the bottom of the hole was only 70 p.s.i. So it had not fully built up before the test.

What that means is, there are transients of unknown magnitude that are occurring immediately before the test was run. That will affect that first flow period, or that first injection period there, much more than any other period.

And then finally, on that piece, there are questions about the rate, because the methodology that they used to measure the producing -- or the injection rate, excuse me -- the methodology they used, they used these orifice plates. They did not note on the chart the size of the orifice or the meter tube diameter or any of that type of information, and thus it's not a calibrated test.

So instead of answering all the questions for me, it leaves me with more questions than I had before. In fact, it was only this morning that I found out through Mr. Robinson's testimony that they didn't have a packer in the hole. Of course, it was only last night when I received Mr. Robinson's analysis that I found out that they were supposed to have a packer in the hole.

So we have a test here that's run not under observed conditions and controlled conditions where we can find out what happened, but rather under conditions that I know the well produced the day before, I know the well was not fully built up prior to the test, and I don't know what the rates or the times were on the test. Accordingly, it makes it very hard for me to establish any reliability in those results.

Now, at the same time I'll mention in response to one of the questions that Dr. Lee had asked earlier there, as far as the effect of wellbore storage and potentially water at the bottom of a well, once that pressure gauge is run down to the bottom of a well, it's reading the bottomhole pressure. Now, how long does it take, once they start injecting, before that water level, if there is a water level in the tubing at that time -- to move down below the gauge?

Well, we know the bottomhole pressure was 70 p.s.i. at the time that the test started, so that corresponds to a head of water of about a hundred and -- what was that? 160 feet, roughly. So that 160 feet of water in the tubing is all that needs to be pushed out in order to push that water down and have gas going in the formation. The rate that they were injecting was 746 MCF per day. At 70 p.s.i., that's a reservoir injection rate of 28,000 barrels per day. It would take only two seconds to push all that water out.

So since they're gathering pressure readings every minute, that water was gone long before they caught their first pressure reading. So the effect of water in the tubing really had no effect on this test.

Q. As a result of the likely inaccuracies in the testing and analysis, in your opinion are Mr. Robinson's conclusions with respect to the permeability in the coal inaccurate?

A. Yes, they are inaccurate.

Q. You heard Mr. Brown's testimony and Mr. Robinson's explanation for the rapid pressure response at the Chaco 4 and 5. Would you care to address that?

A. Yes, I would. We've had some beautiful drawings here, nice colors, such as BR-26 (a) here, purporting to show what happens when one of the Fruitland Coal wells is shut in, if the communication was through the Fruitland Coal.

And then there was also a chart hand-drawn by Mr. Brown -- let's see, one of these; there we go -- where he purported to show an average reservoir pressure in the coal of 102 p.s.i. at the time the coal well would be flowing at 5 p.s.i., and yet have 67 p.s.i. out here 1800 feet away at the location of the Chaco 2-J.

Well, this type of pressure cannot happen. Even very introductory petroleum engineering classes tell us that pressure is approximately logarithmic with distance. So we have -- We look at the distance from a well, and the pressure that we have, drawdown out to here, and an average reservoir pressure at some higher level.

What we get if this is linear with regards to distance is, we have a very steep cone of depression around the well -- and that, by the way, is a technical term, cone of depression -- followed by a long range -- a long way out there before we get to the average reservoir pressure. But right near the well it's extremely steep, in fact, much steeper than I've drawn it here.

And that's why when we shut in a well we get buildup very quickly, if it's a producing well, to something approaching the average reservoir pressure. So if we were to plot this, instead, in terms of the log of the distance versus pressure, what we find is that we get almost a straight line out there, until we're approaching the point where we have an average reservoir pressure interference boundaries between wells.

Now this, then, would be approximately -- Those wells are small, so we're looking at a well that might be one-third of a foot in diameter. Excuse me, one-third -- yeah, of a foot in diameter for the casing.

And so we draw -- and I'll try and draw this approximately to scale, now, though I'm sure I won't be absolutely perfect. So if we go out one foot, we get something like that. By the time we come out ten feet, you know, like so; a hundred feet, like so; a thousand feet -- and you can see, we're just picking up with regards to this distance the pressure.

And then -- Now, when we come out here and we say, Let's look what happens at 1800 feet, we have something right there.

320-acre spacing corresponds to a distance from the well, or an average radius, of 2100 feet. So when we say that we're looking at a 320-acre spacing unit, for example, that means it's only just a very little distance further before we hit the effective edge of that drainage area for that particular well.

So because of this, you can see very clearly here that the boundary pressure and the pressure 1800 feet away would be almost the same. There is no physical way that we could have 6700 -- or 67 p.s.i. as an average reservoir 1800 feet away and 102 p.s.i. as the true average reservoir pressure within an enclosed area that is of a reasonable size.

So now, having examined that, what I'd like to do is draw two pictures where we look at the two different possibilities that were examined, one of them by this where we had -- in BR-26 (a) that showed communication through the Fruitland well, and one of them where we see what would happen if we had communication through the Pictured Cliffs.

So this one I will write "for communication through the Fruitland well", and then side by side here I will draw a chart "for communication through the Pictured Cliffs well".

Now, one of the things that's somewhat misleading here is, we look at a chart like BR-26 (a), and you say, Oh, the coal has a certain thickness there, and the Pictured Cliffs is much thicker in this chart, visually.

But what really happens here is, there is far more gas in the coal than there is in the Pictured Cliffs. And the way that this communication is happening is through a small channel, or a small piece of Pictured Cliffs, which has been called this upper Pictured Cliffs sand. That's only one, two, three feet thick. It's not the whole 25 feet of the Pictured Cliffs. And we're comparing that, now, to the coal that's 18 or 20 feet thick.

So what we have, instead of this type of a view where, in BR-26 (a) it looks like the Fruitland is smaller than the Pictured Cliffs, we have a case where the effective volume of the Fruitland is much larger than that of the Pictured Cliffs, because what we're talking about is, where does this connection occur.

Now, in addition, as I have said before, the Fruitland is much more compressible than the Pictured Cliffs, and so we have a much higher effective

STEVEN T. BRENNER, CCR
(505) 989-9317

compressibility because of gas desorption.

So let's take and ask ourselves, then, to look at this as if it were two tanks hooked up to this well. And we'll just consider two wells for the sake of this discussion so that we can see what would happen.

Well, here is the Fruitland, and it has approximately 18 to 20 feet of thickness, and it has a very high porosity-compressibility product.

Now, what does the Pictured Cliffs look like? Well, here, let's draw the Pictured Cliffs well over here, and we'll say there's no connection here between the PC well and the Fruitland, and over here we will have a connection between the Fruitland well and the PC.

But how big should the PC be, to be consistent? Well, visually it's only got maybe one-sixth of the thickness, and it has approximately half the compressibility. So it should be drawn here looking like it's about 1/12 of the size of the Fruitland.

So what we have, then, is a very large container with a lot of gas, admittedly, in the Fruitland, and a very small container in this upper Pictured Cliffs or WAW sand.

Now, we'll draw the same drawing here, to start with, for connection through the PC well. And I'm sure I can't get these exactly the same, but I'll try and have them be relatively the same.

So here's the Pictured Cliffs zone and the Fruitland zone, here's the PC well. And now we're going to assume that the PC well is open but the Fruitland Coal well here is not.

What happens, now, when we're sitting there producing in either of these two cases? Let's start with communication through the Fruitland well.

We have in the Fruitland a pressure -- And I'm going to go back now to August of 1998, because that's when the shut-in started. At that time the Pictured Cliffs wells had already been shut in for more than a month. We have plenty of information that the reservoir has decent permeability, so they had built up to what their average reservoir pressure was around that well. And you could call this the Chaco 4 or Chaco 5 here. I wouldn't call it Chaco 1-J or 2-J, there are other things happening there. But Chaco 4 and Chaco 5 are the two wells that are clearly responding to the shut-ins on the coals.

So at that point in time we had our average reservoir pressure in the Pictured Cliffs that was approximately 120 p.s.i.a. Then we had an average reservoir pressure in the Fruitland that was approximately 150 p.s.i.a. So this is our average reservoir pressure that we call B bar.

Say we had higher pressure in the Fruitland than the Pictured Cliffs. What did we have over at the producing well? Well, these wells were under compression. They're under -- They're sitting there blowing a lot of gas and pulling a lot of water out. So whether it's 20 p.s.i.a. down here or whether it's 30 or 15, and the number is much less than 150. So we're producing a lot of gas out of the Fruitland Coal.

At the same time, in that case, 20 p.s.i. in this well, in this Fruitland well, is much less than 120 p.s.i. in the Pictured Cliffs. We are also producing Pictured Cliffs gas. And there's no two ways about it: If the connection is through the Fruitland well, when the Fruitland well is producing it will produce Pictured Cliffs gas. That's a fact.

Now, what happens when we shut it in? This well is making some rate. Let's say it's 700 MCF per day. And at that point in time, some proportion -- Most of it's coming from the Fruitland. So maybe we have at that point -- This, now, I'm making an approximate number. This is a number for illustrative purposes. Let's say this is approximately 650 MCF per day from the Fruitland, and that this is approximately 50 MCF per day. We're producing much, much more from the Fruitland than from the Pictured Cliffs.

Now we shut it in. What happens? That 650 MCF per day -- so now this will be the shut-in condition -- is sitting here, it's coming into the well, the well is now sealed at the top. What is the relative pressures here? Well, this Pictured Cliffs does not have anywhere near the compressibility of the Fruitland Coal, so it has a greater drawdown or greater slope here than what -- a greater pressure differential or pressure derivative -- than what the Fruitland does. Once we shut it in, there's a lot of gas here, there's not much here. Gas starts flowing across there. It's that simple.

Then what happens? Well, this is not a very big volume here. So that's 650 MCF per day, which drops off over time fairly quickly after the shut-in, it's sitting here, moving there, through this very small Pictured Cliffs zone to reach the Chaco 4 and Chaco 5. So we see a buildup, very rapidly.

Now, you had heard testimony yesterday or today, I've forgotten which, that the thickness shouldn't matter. The thickness absolutely does matter, because if this Pictured Cliffs zone is twice as large, the amount that's coming out of the Fruitland now is a fixed amount, because the Fruitland is feeding into this 20 p.s.i.a., then we shut it in. There's a certain flow rate the Fruitland can provide. So if we double the thickness here, then it will take longer for that pressure transient to move through the

Pictured Cliffs. And if we cut that thickness by a factor of two, then it can move through much more rapidly.

Now, let's turn around and say, what happens if communication is through the Fruitland Coal well -- or, excuse me, through the Pictured Cliffs well? We do the same thing here. We start out, we write our pressures, 150 p.s.i. and 120 p.s.i. And over here we write 20 p.s.i. to begin with.

Now, what happens? These wells are 1803 feet apart, at least from the 6 Number 2 to the Chaco 4. What pressure should the PC zone be seeing? It has to be seeing something close to the average reservoir pressure of the Fruitland Coal, because while this is producing, and even thereafter, there's some gas moving from there. We have crossflow in that case from the Fruitland to the Pictured Cliffs, because the Fruitland has higher pressures than the Pictured Cliffs.

And we have during this producing phase, now, all 700 MCF per day would have to be coming solely out of the Fruitland in that case.

What happens when we now shut that well in? That pressure wave, once we shut the well in, has got to try and move through this huge volume of Fruitland Coal. And it's a high-compressibility system. It's like we have -- almost like we have two tanks, one of them is a very small tank, one of them is a very large tank. And so it can't move through that very large tank over here very quickly, no matter what anyone says.

This is why you didn't see any calculations from people of how fast this pressure transient could move through the coal, because it doesn't move very quickly. It just flat can't move very fast through there, because of the very high compressibility, and because this volume is so much higher.

But if you take this production here, put the Fruitland Coal back on the communication through the Fruitland well and start shutting in that small, thin Pictured Cliffs zone, it moves through very rapidly. This is what I was trying to show with my analysis of the different cases using the multi- -- the two-layer model approach.

So what I attempted to do was to analyze this mathematically, put numbers to it, and however -- whatever anyone thinks about the numbers, they cannot change the basic fact that most of the storage here is in the coal. And what we're looking at, the very fact that we see a very rapid response says that has to be coming through a very small or a very thin interval.

Now, there's one other factor that I wanted to hit, or wanted to cover with regards to all this, with respect to the coal in particular.

We have heard the term Langmuir volume and Langmuir pressure talked about a number of times, and in Mr. Robinson's well-test analysis you'll remember he had a number of 697 for his Langmuir volume.

Let me just write here -- The formula for the gas content of coal is a very simple formula that basically all people who work with coalbed methane reservoirs intimately know, because it really is pretty simple.

The gas content is the pressure times this factor we call the Langmuir volume, which is a measure of the storage capacity of coal, divided by P plus -- pressure plus P_L, which is Langmuir pressure. So V_L, the Langmuir volume, is simply a measure of the maximum storage or maximum adsorptive capacity of that coal. If you crank pressure up to an infinite level, you can only put so much gas into that coal.

And actually in practice, of course, no one ever goes all the way to infinity. What we do is, we use this equation to match the absorption curves over some period or over some range of pressures. Typically, you might go up to 50 percent more than what your average reservoir pressure is, just to get a good line.

P_L here is a measure of the curvature of the isotherm. So a simple definition for P_L is, that's the pressure at which half of the maximum absorptive capacity of the coal is reached. When pressure is equal to P_L, gas content is one-half of V_L. Very simple equation.

But now if V_L is cranked up or is increased by a factor of four, gas content increases by a factor of four. So this is why this Langmuir volume is such an important factor in the different analyses that we do on coalbed methane.

Q. Now, Mr. Cox, you've listened to the testimony of the Whiting and Maralex witnesses with respect to their opinions about whose frac jobs are responsible for escaping out of zone. How do you respond to those arguments?

A. At this point, all information indicates the Fruitland Coal wells frac'd into the Pictured Cliffs, not the other way around.

MR. HALL: Pass the witness.

CROSS-EXAMINATION

BY MR. GALLEGOS:

Q. If I understand your testimony, and as illustrated in the drawings that you've made, Mr. Cox, the only significant contributory sandstone formation as far as production in the Chaco wells is the seam, sandstone seam, that has been referred to by Mr. Nicol as the upper Pictured Cliffs and by Dr. Ayers as the WAW Fruitland sand; is that correct?

A. No, that's not correct. The rest of the Pictured Cliffs also contributes. What I'm accounting for here is, how does a rapid response occur when the Fruitland wells are shut in, during the shut-ins of the Fruitland wells? I'm not addressing here the total production from the Pictured Cliffs.

Q. The sandstone that you say is one, two or three feet thick, I think you said that's the portion of this sandstone formation that has high permeability?

A. Yes, it has to have high permeability for -- again, in order for that pressure response to have been observed, that's what we go back to. Pressure was observed.

Q. And of course the wells, say the -- the three Chaco wells that were fracture-stimulated, other than the 2-R, have perforations that are open to the lower Pictured Cliffs, or the Pictured Cliffs that is below the Fruitland Coal. You're aware of that?

A. I'm aware of that.

Q. But you don't consider that in terms of your investigation of the transient pressure response?

A. I didn't consider it, because then I needed a three-layer model, and I saw no need to add a third layer, that the response has to be going through a relatively thin and relatively confined layer there.

Q. It has to be thin, the thinness is very important?

A. Well, as you saw on my exhibit -- Let's see here, C-22, where I increase the thickness of the Pictured Cliffs to 25 feet from three feet, then the response was delayed, and I did not -- I was not able to see response in a matter of a couple of days. Rather, it would take many days in order to be able to identify observable response.

Q. Okay. So would you just write for us the equation for radius of investigation that one uses when you're trying to calculate the time it takes a pressure wave to pass through a rock formation?

A. No, the radius-of-investigation equation is not used for this type of an analysis. This is a two-layer system, and the radius-of-investigation formula is, whether -- when you're looking at a single layer, it is an approximation to a velocity through a single layer. It has no meaning for this two-layer case, because you have crossflow occurring.

Q. Well, but what you're attempting to do is say here that I'm going to compare if -- what happens if the pressure is moving through one zone, as opposed to moving through another zone; isn't that correct?

A. That is correct.

Q. So you're dealing with each of those as a single layer that needs to be examined from the standpoint of the radius-of-investigation equation; isn't that true?

A. No, that is not true.

Q. So if you had just a single -- let's say -- Let's assume, then, that all you're trying to do is see what the transient pressure time is through the Fruitland Coal, that's all you want to know.

A. Okay.

Q. Then you would use the typical radius-of-investigation equation?

A. No, I would not.

Q. You still wouldn't use it?

A. No, because I'm not interested in a calculated radius of investigation that relates to a number that you put on a well-test form to help -- as, for example, on a drill-stem test, for an engineer to try and estimate how far out in the reservoir he's seeing.

What I want to be able to see here is not a radius of investigation but rather how much pressure response might be observed at any particular point.

Q. Oh, how much. So timing isn't important, it's quantity, the pressure response?

A. No, if the pressure response is less than 1 p.s.i. with the particular type of measurement, I know that we would not be able to observe that, because they had a gauge that had 1-p.s.i. resolution.

Time is important too, but in this case if you can't observe the pressure change, then you're not going to ever see it.

Q. Well, let's assume that you've got decent gauging so you can observe it if it's a half a p.s.i. or 1 p.s.i. What's important is, you observe the pressure change and the time it takes for that pulse to go from one point to the other?

A. Well, I think if you'll look at my exhibit, that's what you see, are the calculated pressure changes and the time it takes for those pulses to go from one well to the other.

Q. Yeah, and that's -- All of your various curves are just showing that through one formation it takes a longer period of time than the other formation, and you work it until you get one of them that does it in one day, basically --

A. No.

Q. -- isn't that right?

A. No, that's not what I was doing there. What I was doing was plugging in particular numbers to show this type of analysis with specific numbers.

Q. The whole principle of trying to determine this pressure response is to determine the time it takes to move through the formation?

A. No.

Q. It's not a question of whether you see a response of 1 p.s.i. or 10 p.s.i., is it?

A. Yes, it is, because there was observed pressure response, so I was trying to understand how that was happening.

Q. Observed pressure response can be half a p.s.i. in its observed response. And in fact typically, in these kinds of tests, that's typically what you find, isn't it? A response of -- a very small response, maybe a half a p.s.i. or 1 p.s.i.

A. It depends on the particular reservoir and the particular test. I have run interference tests where I've seen hundreds of p.s.i. change in monitor wells.

Q. So if you see a pressure response that takes four days and it's only a half a p.s.i., that's meaningless, but if you see a pressure response that's 10 or 12 p.s.i., then that's what really tells you something, and not the time that passes; is that what you're telling us?

A. No, that is not at all what I'm telling you. What I'm saying is, the pressure response that you can observe does depend on your gauge. The pressure response depends on time. Longer times, you will see greater pressure response. If you can wait long enough, you will see pressure response over long distances at fairly late -- or at very late times. Also, if you have very accurate gauges, you can see response at long distances even for fairly short times.

Now, there are limits based on tidal effects and the amount of noise that you get from a system. But absent that, you can see -- at times you can see a response of less than 1 p.s.i. that is very meaningful in an interference test.

Q. Well, even though you deny that it's to be used in this situation, will you agree with me that the equation for a radius of investigation does not include thickness?

A. Well, of course not, because it's for one layer. It does not include two layers.

Q. I see. So you use some other equation?

A. You can see my equations, I included them in --

Q. Oh, yeah --

A. -- Exhibit B there.

Q. Okay. So when you solved for time with the two layers, then you must include a thickness?

A. That is correct.

Q. Okay, so this conduit that you're seeing whether a pressure wave can pass through it, this conduit, it's all-important whether it's 10 feet thick or 3 feet thick --

A. Well, the thickness --

Q. -- or 15 or whatever?

A. Yeah, the thickness is one of the variables. The other variables are those that are listed in -- I believe it's Table C-1 of my report.

Q. And so by your approach or your theory, the fact that you say that we can see a response through a 150-millidarcy within one day is only valid, or is only usable, if we also understand that that's a very thin formation? Is that what we're to understand?

A. In this case, all the other properties being constant, the answer is yes, because if the Pictured Cliffs here were much thicker, then the amount that would be coming crossflowing from the Fruitland Coal well to the Pictured Cliffs would be a smaller volume. And so we have a material balance here between how much -- Whatever crossflow comes out of the Fruitland goes into the Pictured Cliffs when a well is shut in.

Q. But we're talking about pressure, Mr. Cox, not flow of gas. When you're talking about a pulse, what we're talking about is -- I might analogize to throwing a rock in a pool of water, and the rings going out; isn't that right?

A. No, that's actually a poor analogy because that's -- A pressure wave that comes in, that's handled by what we call the wave equation. The flow of fluid in porous media is handled by what's called the diffusivity equation. It's an entirely different equation, and the properties of solutions of those two equations are different.

Q. Well, maybe my analogy wasn't perfect, but what we're talking about is having one well shut in, then shutting in another well, and a pulse of pressure, pressure, not crossflow of gas but pressure moving through a reservoir, isn't that what you were investigating?

A. Pressure only -- Pressure and rate, or pressure and volume, are tied intimately with each other through the equations of flow. If you have no flow, then pressure becomes meaningless.

Q. All right. Just another question or two on this particular subject. You emphasized and must have said four or five times, coal has a very high compressibility, as you were drawing it. That was something that you wanted to emphasize that was of importance in the outcome of making your calculation?

A. Yes, that the total compressibility, which is comprised of the compressibility of the coal itself as a material, plus the compressibility of the water in the coal, compressibility of free gas, and then once gas is desorbing, the largest piece is the desorption compressibility, all add to that compressibility term. So it's the compressibility of the entire system.

Q. But to actually solve the calculation, what you use is not compressibility alone, but you use the porosity-compressibility product; isn't that correct? And in fact, that's what you used in your analysis?

A. That is what I used, because the -- As far as the movement of pressure through a formation, when you're looking at it from a pressure-transient sense, the porosity and compressibility are inextricably linked.

Q. Right, so you used the product?

A. That is correct.

Q. And your own testimony we saw, when you did that, the difference was, for the coal, .0018 and for the Pictured Cliffs .0013?

A. For that particular set of parameters, yes.

Q. And that's not a drastic difference, is it?

A. It's a factor of two, but, in addition --

Q. A factor of two? 18 to 13, a factor of two?

A. Okay, 1.5, the .0025 versus --

Q. It's not 1.5 either.

A. Excuse me, can I finish my statement? The factor of .0025 that I had in Table C-1, versus the factor of .0013 is nearly a factor of 2. But in addition --

Q. Which you ceased using after your first two analyses; isn't that right?

A. Yes, I did.

Q. On the other five analyses you used the .0018 to

.0013; isn't that correct?

A. I don't remember --

Q. You answer it yes or no.

A. Oh, the .0018 was for the Fruitland and the .0013 was for the Pictured Cliffs --

Q. Thank you.

A. -- that is correct.

But if I may finish my statement, the other factor that we have here is that these Fruitland wells have recovered more gas than can be accounted for by that isotherm, so there's an indication that their gas content is higher, and thus the compressibility of the Fruitland Coal would be proportionately higher. And therefore, that number is more likely a factor of two. If we use 130 instead of 110 for the gas content, then it will rise in the ratio of 1.3 to 1.1. If you used 166, and so on, it would be in proportion.

Q. I though when you raised the coal content you lower the compressibility, don't you?

A. No, sir. If you will look at my Exhibit C-64 here, the ϕc_d, which is the desorption compressibility-porosity product, is directly proportional to the gas content.

Q. That's what I'm asking. I just want to be sure of your testimony.

If you have -- Let's use two examples. If you have 110 standard cubic feet per ton, and the other example is 130 standard cubic feet per ton, you're saying that the 130 standard cubic feet per ton does not result in a lower compressibility?

A. No, it does not. It results in a higher compressibility.

Q. All right. Let me just ask you a few questions about the injection falloff test. You understand that the purpose of this injection falloff test conducted by my clients was to obtain some indication of the permeability of the coal?

A. That's what I've been told, yes.

Q. All right. And you have various criticisms of the test, and I just want to ask you about a few of those. You pointed out to the Commission that if you look at what we might call different clocks that were used, there could be different times for the injection period of the test. I think 10 hours, 12 hours or 13 hours --

A. That is correct.

Q. -- would make no difference in the result of the calculation of the permeability value, would it?

A. Yes, it would.

Q. You also made an observation about the rapid pressure increase. I may not be stating that quite correctly. What was your criticism about the pressure increase -- Well, I thought that's what it was, that you saw a rapid pressure rise at the initial stage of the -- from zero time correction?

A. Yes, what I was saying there is, if you look at Exhibit Robinson-B, the pressure when injection started was 70.15 p.s.i.g., and the pressure number that was used in Mr. Robinson's analysis for the -- and, you know, again, I heard the numbers this morning, but he has actually four different pressures.

There's pressure at time zero, which I think is what corresponds to the 70.15.

He's got a number of 94.75. He also has adjusted pressure at time zero and corrected pressure at time zero and adjusted corrected pressure at time zero.

So you can take your choice of those four, but none of the are 70.15 p.s.i.

Q. And that would influence what? The skin factor? Anything other than the skin factor would be influenced by that?

A. Oh, yes, because what it does is, it changes the shape of these curves. Instead of being at this point, the curve -- this red curve, which is the pressure curve, comes out higher.

The derivative curve will be in the same general spot. However, because he's using what he calls his adjusted pressure, which ties back to a well gas potential, the starting point of that also affects the value of this dimensionless pressure that he's doing here and can potentially change the curvature of this, and it would have to be rerun now that we've heard his testimony as to what that is, it would have to be rerun with 70.15 to find out what effect that would have.

Now, I don't recommend that that be done, because there's all these transients that occurred prior to the beginning of injection, and I don't know what rates those were or the timing of that either.

Q. So what would be in your mind a properly controlled injection pressure test would be a suitable means for obtaining a value as to the permeability of the Fruitland Coal; do you agree with that?

A. In general, yes. However, I will point out that many times, especially when coals still are producing both gas and water, a single test is not sufficient to determine that, but sometimes multiple tests are needed because you have problems with the test.

In this case, as we just heard yesterday and discovered, two tests were run on this before they -- It was only the second test that they got what they felt to be a good test and that I've expressed these reservations about.

Q. That might happen, you might have to take two tests or even three tests, to be sure that you've got a well-control test, correct?

A. That is correct.

Q. But then if you had that, you'd have a good, suitable basis for arriving at your permeability valuation for the coal in this area?

A. Within the range tested, yes, or within the distance around the wellbore that's tested.

Q. Well, within that area?

A. That's correct.

Q. All right. And you came on board with Pendragon and Edwards as a consultant on this case -- what? In April of this year?

A. Well, I believe I was contacted -- I think it may have been February or March, I can't remember. It might even have been January. Sometime in the first quarter.

Q. Early on, okay. Well, I just picked April. I thought that was at least the latest, because you filed an affidavit in this case in April of 1999.

A. That's correct.

Q. But you actually came on and started advising them in January or February?

A. Or maybe it was March. I can't remember.

Sometime earlier than that, because I had been tied up on other things and hadn't had a chance to look at it until I believe it was -- what? April 22nd or so that I did that affidavit.

Q. And sometime by -- is it fair to say, by March of this year, you understood that this matter was coming to hearing in August of 1999?

MR. HALL: I'm going to object to that. It assumes facts that aren't in evidence. I don't think that was known at that time.

MR. GALLEGOS: Well, what --

CHAIRMAN WROTENBERY: I can't remember when we --

MR. HALL: I don't think we knew that until May.

MR. GALLEGOS: We had a scheduling conference, I believe, in March.

Q. (By Mr. Gallegos) But anyway -- Let me just put it this way. That's not critical. This matter was going to be coming to hearing in July or August of this year --

A. I did not --

Q. -- you were informed of that, weren't you?

A. No, I did not know when it was coming to hearing.

Q. Well, did you know it was going to be coming to a hearing, that you were going to be having to present testimony in this matter back in February when you were employed?

A. First off, I'm not sure whether it was February or January or perhaps March. For that matter, it might have been December. I don't remember. I'd have to go back and look at my calendar.

But secondly, I wasn't employed, I was retained as a consultant. And no, I didn't know that I'd necessarily be sitting here talking. Rather, I was asked a question by Mr. Nicol as to whether that response information might be -- whether it would be possible to evaluate that.

And I looked at that information and said yes, that based on formulating these equations and making some preliminary runs, it did look as if a test could be conducted to evaluate the interference between wells. And then I designed such a test.

Q. And in order to do that, Mr. Cox, you would have to use some number for the permeability of the Fruitland Coal to do your tests, correct?

A. That's correct.

Q. Okay.

A. Wait, excuse me. To design the test, yes. But the test would be run to determine reservoir properties, not to assume them.

Q. All right. The test would be run to determine one of the key properties, which would be the permeability rating of the Fruitland Coal in this area; is that your testimony?

A. No, it is not. The test as I had designed it there was designed to determine which wells were interfering with which other wells. It was not designed to determine the permeability of the Fruitland Coal.

Q. All right. You would -- In order to perform your test, you would need to use some number, assign some number to the permeability of the coal and some number to the permeability of the Pictured Cliffs; isn't that true?

A. No, those would --

Q. No?

A. No, I can run the test out in the field without having to know those numbers.

Q. You didn't run any tests out in the field, did you?

A. No, I proposed tests and they were not run.

Q. But we have -- You know, we're arguing over something I think we don't need to, fundamental. Your Table C-1 says you have a certain input data you use, and you have a permeability for the coal, and you have a permeability for the Pictured Cliffs, your 20 and 150, respectively; isn't that true?

A. That's what Table C-1 shows, yes.

Q. All right. And so in order to do your tests, you're going to have to input in your calculations a permeability for each of those formations?

A. I think you're confusing designing or analyzing a test with doing a test.

Doing a test is either going out in the field yourself or having people go out in the field and physically run a test.

Designing a test, you can plug in different numbers to see what potential effects there are so you can determine how long should the test be run, what types of gauges do we need, and so on. That's test design. That's not doing the test.

Q. Well, I don't think I'm confusing it with anything. I think we can get to where we're going pretty easily here if you just simply will confirm that to do your test you had to assign some kind of permeability value to these respective formations?

A. No, you do not have to. To do the test, that's physically going out and doing the test.

To analyze the test, you will try different values or you will use the information to then either determine the reservoir properties or to determine a range of reservoir properties --

Q. Well --

A. -- just as -- if I may finish, please -- just as

Mr. Robinson attempted to do with his estimates here. That's actually taking and analyzing the test.

Doing the test is the physical act of going out and doing the test.

Q. Well, I'm using the wrong word. Let me -- If we use "analysis" will that work? I'm talking about your calculations, Mr. Cox, where you take the input data and you do an interference analysis. Will that -- Can we use that word?

A. We can --

MR. HALL: Madame Chairman, I think at this time I'll interpose an objection. I think we've covered this ground beyond the point of exhaustion now. And I'll also point out, I don't understand why we're getting into this area when it was Whiting and Maralex who opposed testing all along in any event.

CHAIRMAN WROTENBERY: I don't really think we're trying to talk about testing --

MR. GALLEGOS: No, we're not.

CHAIRMAN WROTENBERY: -- I think we're trying to talk about permeability factors that are used in the interference analysis.

MR. GALLEGOS: I'm just trying to get what I thought would be a very simple answer to a simple question, is that in making your analysis you assign certain permeability values to the coal and to the Pictured Cliffs formation.

MR. HALL: And again, Madame, Chairman, I think the question has been asked and answered a number of times now.

MR. GALLEGOS: It has not been -- It's been asked a number of times, I agree with that.

CHAIRMAN WROTENBERY: I haven't heard an answer to it either yet. I think Mr. Cox has been talking about the testing, as opposed to the interference analysis. I may be wrong, but go ahead and clarify.

THE WITNESS: Actually, the way the question was just now asked I can answer it as, indeed, yes, the analysis that I did, as presented in my written testimony, was based on certain permeability levels that were utilized for the different formations.

Q. (By Mr. Gallegos) Are you aware, Mr. Cox, that Pendragon and Edwards own and operate Fruitland Coal wells in the same vicinity as the wells that are under investigation here?

A. I'm aware that they have some wells. I don't know where those wells are.

Q. Well, did it occur to you that in order to have a permeability value for the Fruitland Coal you should ask your clients if they have coal wells? And if you found that they did, you should recommend that they go out and make injection falloff tests?

MR. HALL: Object to the form of the question.

THE WITNESS: And for what purpose would I do that?

Q. (By Mr. Gallegos) For instead of plucking 20 millidarcies out of the air to use in your analysis, you would have a value that was derived by actually testing the formation; that would be the reason. You don't accept that?

A. No, I don't, because once again you're confusing the reasons why I did analysis 1 here.

The reason I did the first analysis that's contained in my report -- and that analysis was conducted back in March or April of this year, so long before the rest of this report was prepared -- the reason that I did that was to determine whether it would be possible through testing to see, or to -- with reasonable values, what I thought were reasonable values to plug into the equations -- whether or not it might be possible to see pressure interference through the wells, or at the wells, based on that type of a test.

So that number of 20 millidarcies was a number, as you say, pulled out of the air, based on my years of experience working with coalbed methane reservoirs. At that time I hoped or expected that the tests I had proposed would be done. Then, had that test been done, I would have evaluated that test to get those numbers, and then it would have been numbers from this specific area, rather than numbers from some other area.

Q. Well, do you know whether or not -- I thought you indicated you didn't have any knowledge whether or not your own clients have coal wells in this same area?

A. No, I said that I know they have coal wells. I don't know where those wells are, specifically. And in addition, at the time that I prepared analysis 1, no, I didn't even know that they had coal wells at that time. I was simply looking at the potential for that type of testing.

Q. If your clients themselves have coal wells, they don't need permission from Whiting, they don't need permission from the OCC or anybody else to go out and do an injection falloff test on those wells, do they?

A. Not that I'm aware of.

Q. Okay. And if a coal well that your clients have is a section away or two sections away, are you telling us that that wouldn't be a reliable subject to be tested so that one could derive the permeability of the coal by testing, rather than by just assuming a number?

A. One could derive the permeability by testing.

Testing costs money, and in this particular case what I was interested in doing was seeing the effects around Chaco 4 and Chaco 5.

My client does not have any wells that are interfering with Chaco 4 and Chaco 5, so there was no reason for me to recommend that they go and test their wells to try and find out what was happening with regards to Chaco 4 and Chaco 5.

Q. I'm not asking you that, that isn't even the question. The question was a recommendation to them to go test their coal wells in this same vicinity so that you would have a permeability value for that formation, rather than just an assumed permeability value, and I think the answer is clearly, you did not make that recommendation?

A. I did not make that recommendation. I didn't think it was necessary.

MR. GALLEGOS: That's all.

CHAIRMAN WROTENBERY: Commissioners, any questions?

COMMISSIONER LEE: No.

COMMISSIONER BAILEY: No.

REDIRECT EXAMINATION

BY MR. HALL:

Q. Briefly, Mr. Cox, do you know if Pendragon has any coal wells that are of the same quality and exhibit the same properties as the Gallegos Federal Fruitland Coal wells we've been examining here?

A. Not that I'm aware of.

MR. HALL: Nothing further.

CHAIRMAN WROTENBERY: Thank you, Mr. Cox.

THE WITNESS: Thank you.

MR. HALL: At this time we would recall Jack McCartney.

CHAIRMAN WROTENBERY: Mr. McCartney, you're still sworn.

MR. McCARTNEY: I understand.

JACK A. McCARTNEY,

the witness herein, having been previously duly sworn upon his oath, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. HALL:

Q. Mr. McCartney, you've been present to hear the testimony of Mr. O'Hare and Mr. Brown and Mr. Robinson, presented on behalf of Maralex and Whiting, the past couple of days.

Let me ask you, they stated certain conclusions and opinions with respect to the depletion of the Pictured Cliffs reservoir. How do you respond to that?

A. Well, one of the -- It appears to me, one of the cornerstones of Whiting's testimony is that the PC in this area is depleted, or at least this portion of the WAW field. This simply isn't true.

The facts are that Chaco wells have pressures, in 1995, in the range of 150 p.s.i. At that same time, the coal had pressures of 200 to 210 pounds. Whiting relies on the potential for an acid job to communicate -- and they term it "pressure communicate" -- with the coal, with absolutely no flow. I don't think there's anybody in the room, except maybe a couple people, that would believe you can communicate pressure and increase pressure with absolutely no flow.

Secondly, the Chaco 2-J currently has a pressure of in excess of 190 pounds. The problem is now that the coal has a pressure around 100 pounds. So that shows there's absolutely no communication with that well.

Both Mr. O'Hare and Mr. Brown finally recognized that well-loading and water-logging off PC wells is a problem in this area. If you have any water in the well at all, the surface pressures that you read on those gauges is not going to be representative of the reservoir pressure. Those gauges, or those pressures read on the surface will, in every case, always be too low to represent the reservoir pressure, if there's water in the well.

The pumpers -- or at least one of the pumpers working for Walsh Engineering just told me that they fight well-logging every day in those PC wells. The PC wells do make a little bit of water --

MR. GALLEGOS: Objection.

THE WITNESS: -- because of logging off.

MR. GALLEGOS: Wait a minute, Madame Chairman. Now, if the pumper is going to testify about something, he can testify. We object to Mr. McCartney testifying, that's hearsay, and move that it be disregarded.

MR. HALL: Experts are allowed to do that every day. It's part of their opinion testimony.

MR. GALLEGOS: The witnesses were available. They should have been asked that question if they had that information. This isn't the kind of thing, exception for experts or just bringing hearsay from somebody else's supposed factual observation.

MR. HALL: No, that's not right. Expert witnesses are entitled to opine based upon hearsay testimony.

CHAIRMAN WROTENBERY: I guess the thing is, I didn't hear the opinion that flowed out of that. It seemed to me just a statement of --

MR. HALL: Yeah, I --

CHAIRMAN WROTENBERY: -- just as --

MR. HALL: -- understand. I think --

CHAIRMAN WROTENBERY: -- just as a matter of --

MR. HALL: I think he's explaining the basis of his opinions, in part, while he's testifying.

THE WITNESS: Well, my opinion based on that is that most all of those earlier pressures that were recorded in the PC are erroneous as far as true representations of true reservoir pressure, and the reservoir pressure was much higher than that during that period of time, and that the use of those pressures would lead one to think the PC was depleted when, in fact, the PC was not depleted.

The PC is partially depleted, it certainly is not at original pressure. It's around 150 pounds, which is some, oh, maybe 62 percent of the original pressure. So there has been 30-some percent depletion in the reservoir, but it certainly is not completely depleted.

In addition, I prepared an exhibit to illustrate the drainage areas that, in my opinion, existed as of the end of January of 1995, in about a 20-section area in and around the area of discussion in this hearing.

Q. (By Mr. Hall) For the record, is that what's been marked as Exhibit M-A --

A. Yes.

Q. -- M for McCartney, -A?

A. Yes.

Q. All right, go ahead and explain that, please.

A. Exhibit M-A is merely a representation of the size of drainage areas if we would assume a reservoir thickness of about 25 feet, about 25-percent porosity, 65-percent gas saturation and 75-percent recovery efficiency, and look at that potential drainage area as of the end of January of 1995, which is prior to the frac'ing of the Pendragon wells.

You'll see on the area, drainage is depicted by the circles shaded in gray, and the areas that are not shaded in gray are representative of areas that at that time had -- basically were not depleted, or there's no depletion, potential depletion, in those areas.

So from this map, it's clear to me that there's a considerable amount of area that's yet to be produced, and that area holds a considerable amount of PC gas.

There had been talk about -- I believe Mr. Robinson's exhibits, I believe it's his -19 series, (a), (b), (c), (d) -- that he depicted the numerous circles, and he inferred that the dry holes and the shut-in wells -- not the dry holes, excuse me, the wells that were plugged, the wells that were shut in and the wells that were still complete -- producing, he represented that that's why these wells are -- the Chaco wells -- are only going to drain some 130 or so acres apiece, on average, because of offset production, offset pressure interference.

My analysis, based on the production surrounding, particularly the Chaco 4, Chaco 5, Chaco 2-R and even the Chaco 1, shows that that, to me anyway, is not a determining factor in limiting the drainage areas.

Mr. O'Hare testified that the PC is a nice, uniform sand, and I believe that that, coupled with the testimony about high permeability -- I believe the witnesses all testified that the Pictured Cliffs has high permeability in this area, with the exception of Mr. Brown. And in Mr. Brown's opinion high permeability must represent Prudhoe Bay, and he confessed that he thought the permeability might be in the 50-millidarcy range. And to me, 50 millidarcies in the gas reservoir is very good permeability.

If we have 50 millidarcies, and we have 100 pounds shut-in pressure and we have 40 pounds flowing pressure, that will produce some 300-, 400 MCF-a-day rate.

So 50 millidarcies is extremely good permeability, and it doesn't take a whole lot of pressure drop to create high gas flow with 50 millidarcies.

With respect to the testimony on volumetrics by Mr. Robinson, I was somewhat surprised that Mr. Robinson testified that on the Chaco 2-R, which he represented in his testimony to have nine feet of pay, that that pay was based on other wells, and not the 2-R itself. I personally have not -- If I have well-log information on a well, I certainly honor that well-log information. The log on that 2-R is in front of you, and I believe my written testimony and potentially my verbal testimony indicated that I believe that has about 24 feet of pay, not 9 feet of pay. Of course, the detail of my volumetrics is given on Exhibit M-37.

In addition, the volumetric numbers that I show on M-37 are based on 160 acres, although you should not confuse the 160 acres with potential drainage area.

The other matter -- One of the other matters I wanted to discuss is damage. Mr. Robinson evidently heard something in my testimony which I don't believe I stated when he said that I said that the permeability throughout the entire reservoir decreased over time. That's a misstatement, a mischaracterization of my testimony. I did not say the entire reservoir decreased over time.

I did show in my Exhibit M-25 a decrease in permeability represented solely in the calculation of permeability. Maybe it would have been better if I had said the transmissibility decreased, which is the product of the permeability times the thickness, divided by the viscosity. But since thickness and viscosity are constant, or relatively constant in these pressure ranges, the only variable is permeability.

I could have done productivity index, which is so many MCF a day per pound-squared pressure drop, but I get the same result. In every case, the transmissibility, the productivity index or, in my terminology there, what I use, which -- I think I said effective permeability -- those factors, a combination of those factors decreased over time.

The bottom line of that is that that dramatic reduction in transmissibility resulted in the PC wells having impaired flow condition, so they were not able to flow the kind of gas that they should have been able to flow at 100 pounds, 80 pounds, 125 pounds or even 150 pounds pressure.

What caused this? Causes could be scale, mobile fines, water blockage. They're all probable causes.

Mr. Robinson suggested that maybe reservoir compaction might be a factor. I would have had to stay up late at night to come up with reservoir compaction as a material factor in an 1100-foot underpressured reservoir, so I don't think compaction is even a consideration, as far as reduction of transmissibility in this reservoir.

Scale is definitely a wellbore problem and potentially could be a problem near the wellbore.

Migrating fines, a laboratory report that was presented earlier talked about that, migrating fines and clays.

Water blockage, Mr. Robinson states that water blockage can't happen, cannot happen, while the water is flowing. But what happens when the well logs off? The water is no longer flowing. What's happening to the water in the wellbore? It's getting imbibed into the formation. So you can get imbibed into the formation near the wellbore and wherever that water is present, and that increased water saturation causes reduced permeability, causes blockage, which in this case was remedied through fracture-stimulation.

In addition, Mr. Robinson said they could have done well tests. In fact, there were well tests run, a whole series of them. I believe Table -- or my Exhibit M-25 shows those well tests, those annual deliverability tests. The word "test" is their last name. If you would look at that, which I did, you would see that decreased permeability.

He had suggested, well, let's run a multiple-flow test, multiple-rate flow tests. The problem is, we've got wells that produce 2, 3 MCF a day. It's a little hard to measure that quantity of gas, number one, and it's a little bit hard to get a multiple-rate flow test. And chances are, there's water in the wellbore anyway, and you'd have to worry about multi-phase flow in the reservoir.

He also stated that he had never seen a 1-MCF-a-day increase to 200 or 300 MCF a day. Those things are just about logged off, and some of them -- you know, there's virtually no transmissibility left because of -- call it reservoir damage, call it reservoir damage, logging off, whatever. If the native permeability in the rock is 50 millidarcies, well then you remove that skin, you put 150 pounds pressure on it and you give it 40 or 50 pounds line pressure, it will produce 400 MCF a day, and that's exactly what happened. They would like to ignore that.

The last thing I want to comment is his calculation or his interpretation of what gas has been produced from the PC wells, what he calls Fruitland gas from the PC wells.

It appears to me that if somebody is taking somebody's gas, it's the person that gave the large fracs to the wells, that put the compressors on, that have a flowing bottomhole pressure of 20 or 30 p.s.i.a., causing a great big pressure sink, not only in the coal seam but also in the PC, which encourages the PC gas to be produced through those wells.

The only direct physical evidence we have of lost-gas reserves is represented by the drop in pressures that we saw during the shut-in period this last year in the Chaco 1, Chaco 4 and Chaco 5. That is the only real direct physical evidence we have. And there's calculations in my report that quantified the volumes that would have been lost to result in those pressure drops.

And if you want to know where the gas is going, you can look at my Exhibit M-35, which in my opinion demonstrates who's taking whose gas.

Q. Mr. McCartney, was Exhibit M-A prepared by you?

A. Yes.

MR. HALL: At this time we would move its admission and we pass the witness.

CHAIRMAN WROTENBERY: Any objection to the admission of M-A?

MR. GALLEGOS: No objection.

CHAIRMAN WROTENBERY: It's admitted.

Questions for Mr. McCartney?

CROSS-EXAMINATION

BY MR. GALLEGOS:

Q. Mr. McCartney, I'm going to hand you the entire well files that were produced by Pendragon. W-5 is on the Chaco Number 1, W-6 is on the Chaco 2-R, W-7 is on the Chaco 4, and W-8 is on the Chaco 5.

Let me ask you, first of all, are you aware of who the owners and operators of these Chaco wells were prior to the time they were acquired by J.K. Edwards at auction, clearinghouse auction, for $7800 in December of 1994?

A. I could be wrong, but I believe it was Merrion and Bayless. They're -- At least Merrion shows up as the operator.

Q. All right. Do you have any knowledge concerning the competency and quality of operation in the San Juan Basin of the oil and gas properties by Merrion, Merrion Oil and Gas?

A. The only comments that I've heard is that they're very frugal.

Q. Anything to indicate that they're a bad operator or that they don't operate in a way to serve their own economic self-interest?

A. I don't have any information that would give me -- make a judgment one way or the other.

Q. All right. I'm confident that these files are not something that have to be examined now. You certainly have gone through all of the sundry notices, reports, dailies, everything else in the complete files on these particular four wells, have you not?

A. I'm not sure I have, without examining the files.

Q. Well, you wouldn't come here to testify with your various theories that there might have been damage by scale or by fines or this or that, without looking through the well files to see if the operators who had these wells and operated them for some 20 years had not made some kind of observation about that, would you?

A. Well, I would certainly investigate before I'd make such statements.

Q. All right. And isn't it true your investigation would tell you that in those well files you find no indication, no observation of damage of the sort that you and the other Pendragon witnesses have been hypothesizing here?

A. Well, that wasn't the source of my investigation in determining that there was scale problems in the field.

Q. Well, but I'm just asking, when you -- The wells were operated by an operator, and in the well files there is no indication, no observation of damage being detected of the kind that you've attempted to describe here; isn't that true?

MR. HALL: Well, I'm going to object. It asks him to opine on the contents of what looks like about a six-inch stack of paper that he hasn't had the opportunity to review right here today --

MR. GALLEGOS: Well, I didn't --

MR. HALL: -- so I would object.

MR. GALLEGOS: I didn't imply he had reviewed it here, but I --

MR. HALL: That's what the question is for.

Q. (By Mr. Gallegos) Well, have you made a thorough investigation so that you can hypothesize here about the possible existence of damage in these wells?

A. Well, I told you that my source of the scale problems was from conversations with field personnel that related that to me, from their experience and from their observations. I don't care -- I don't know, and I particularly don't care whether Merrion wrote a document or a thesis on scale and put it in the well file. I didn't need that to determine that as a probable cause of wellbore problems.

Q. Okay, so scale is the problem that you rely on for saying that the wells were damaged and therefore not producing in accordance with their true capability?

A. That's one of the factors that needs to be considered. That's not the only factor.

Q. Well, but you say you have some evidence of scale because the pumpers told you something, correct?

A. That is correct.

Q. Okay. And then the rest -- the other possibilities of mobile fines of water blockage is simply an assumption on your part?

A. Well, the mobile fines certainly is not an assumption. I believe you've got a document on your desk right in front of you that talks about that.

Q. Oh, the Lansdale Federal --

A. There's some --

Q. -- core?

A. -- core-analysis work that was done, yes.

Q. And the pumpers you referred to are of the Pendrag- -- or Paul Thompson pumpers?

A. I've talked to at least to one of his pumpers and to Mr. Thompson personally, yes.

Q. And that was here in this hearing, correct, or as we had recessed and --

A. Well, I've talked to him today and I've talked to Mr. Thompson on numerous previous occasions.

Q. I didn't see anything in the various field reports and the workover reports by Walsh Engineering that made a reference to scale on the wells. Can you point that out to us?

A. I haven't looked for that, and no, I can't point it out to you.

Q. Okay, nothing documented that you can point to?

A. I don't know if it's documented or not documented.

Q. Okay, so you're going on -- somebody said that to you?

A. Somebody's actual observation of the occurrence of scale in the field.

Q. Is it your testimony that this occurrence of damage is something that is pervasive throughout the entire WAW-Fruitland-Pictured Cliffs field?

A. No.

Q. So this untapped reservoir of large reserves in the Pictured Cliffs formation is concentrated only in this area of the Chaco wells; is that your testimony?

A. I have not investigated the entire 200 or 300 wells in the WAW-Pictured Cliffs field. I have investigated the immediate area.

Q. Okay, but if you look at the other 200 or 300 wells in the area -- and we've accumulated them on Exhibit W-30 -- you see basically the same production history and decline as you do in the Chaco wells; isn't that true?

A. No, that's -- Not in my opinion, you don't.

Q. All right. Wasn't this field basically down, by 1985 or 1986, down to almost minimal production in all of the wells?

A. No, I don't think you could characterize that. I have reviewed those wells, and the High Roll Number 4, for instance, I think is producing pretty well. The Chaco Plant Number 1 is producing pretty well. And they don't appear to be depleted to me, in this immediate area. And if you look through the other curves you'll find some wells that have substantial production and some that are producing quite well.

Q. Okay, so out of 200 or 300 wells, you can point to those two?

A. No, I can probably point to maybe a dozen or more wells that are substantially better wells than the wells in question in this case.

Q. Well, so you're saying if there is a larger area here, where if everybody was as receptive as Pendragon and you, they would be going out and buying these abandoned or shut-in wells and be fracture-stimulating them and recovering 400 MCF a day from those wells?

A. Well, that's kind of a coincidence that you mention 400 MCF a day. I think on that Exhibit M-A, there's a well on there in Section -- I think it's in Section 2 of 26 North, 13 West, that's kind of handwritten in there, called the State 2-R. That well, for some reason did not appear on Mr. Robinson's Series BR-19 exhibits. It's my information that well is a PC well making about 400 MCF a day, that was drilled within the last couple of years.

Q. Okay, and fracture-stimulated?

A. Yes.

Q. In a Pictured Cliff formation directly underlying the coal formation?

A. Well, the PC is under the coal, yes, and it was fracture-stimulated.

Q. So we don't know but once again we have a Pictured Cliff well that's producing coal gas; isn't that right?

A. No, I don't think that's right. It seems to me like Whiting would like to believe that every good PC well produces coal gas in this area, whether it's --

Q. Well --

MR. HALL: Excuse me, let him finish.

THE WITNESS: -- the Chaco Plant 1 --

MR. HALL: Go ahead and finish.

THE WITNESS: -- whether it's the Chaco Plant 1 or whether it's the High Roll or whether it's the Chaco Plant -- or the Chaco 4, the Chaco Plant 5, the Chaco 5, the Chaco 2-R, even the Chaco Number 1, the Chaco 1-J, the Chaco 2-J, which are virtually nonproductive wells, every one of them in Whiting's opinion is communicated with the coal.

There's no indication that I have from talking to the people who go to that well -- the pumper goes to that well every day -- that that thing is a coal well, that State 2-R. His opinion, which I believe the pumper myself, can tell the difference between a coal well and a PC well out there since he works with them all the time, and from my conversation with him it's my opinion that his belief is that that's a PC well.

Q. (By Mr. Gallegos) All right. Well, I'm sure that's highly reliable, Mr. McCartney, but let's talk about what --

MR. HALL: I'm going to object to Counsel's testifying like that.

MR. GALLEGOS: Well, if this expert is basing his opinion on what some pumper decides a well is, I mean, I think that's worthy of observation.

Q. (By Mr. Gallegos) Mr. McCartney, let's talk about what one would like to believe, as you put it.

Your 150 pounds of pressure that you cited was a pressure taken after fracture-stimulation of the Chaco wells; is that correct?

A. Incorrect. No. No, one or more of those wells -- well, more than one, had pressures in excess of 150 pounds prior to any stimulation, any fracture-stimulation of the well.

Q. After acidization?

A. They may have been acidized.

Q. All right. After they were acidized. And your reference to 400 MCF a day is after the wells were fracture-stimulated; isn't that correct?

A. In that case, yes, that's correct.

Q. All right. And your P/Z curves, in which you calculated the reserves that you think are available from these Chaco wells were based on production history that included volumes of gas produced after the wells were fracture-stimulated in 1995; isn't that true?

A. You include all volumes of gas produced from the gas produced from the well, yes.

Q. Yes, sir, including those very large volumes, in fact, that exceeded the earlier volumes that were flowed between May of 1995 and June of 1998?

MR. HALL: I object. I think that mischaracterizes the prior testimony in this case.

Q. (By Mr. Gallegos) That's exactly the testimony. Just to be clear, to do your P/Z curve, you're including the production after the Chaco wells were fractured; isn't that right?

A. Are you going to rule on the objection?

MR. HALL: The problem with the --

CHAIRMAN WROTENBERY: Mr. Gallegos restated the question a little bit. Do you still have the objection?

MR. HALL: Okay, yeah, why don't you just restate it, Gene.

CHAIRMAN WROTENBERY: Well, he did.

MR. GALLEGOS: I just did.

THE WITNESS: Well, in answer to the question, again, I think I just stated, I used all the production, yes.

Q. (By Mr. Gallegos) All right. And your volumetrics were calculated using production volumes that resulted after the wells that were fracture-stimulated by Pendragon in 1995; isn't that correct?

A. That's incorrect, that is not correct.

Q. You did not use those production --

A. Not in the volumetric calculation, no.

Q. All right. Well, on your P/Z in your -- where does the -- The material balance calculations are made in support of which of your approaches to the reserves that you say are available in the Pictured Cliff formation to these Chaco wells?

A. The P/Z curve is a graphic representation of the material balance calculation for a gas reservoir.

Q. All right, okay. So let's just see if we can be clear on this. Your 400 MCF a day that you throw out, which occurred in the Chaco 4 well, I believe, and your P/Z calculation of reserves for these wells are based on the assumption or the belief that you would like to have, that the gas is flowing totally from the Pictured Cliffs formation and not from the coal formation; isn't that correct?

A. Well, I can't characterize as correct a belief that I would like to have. It's the methodology that I employed, and yes, I do believe all that gas came from the

PC formation.

Q. Okay. Your assumption is based on the source of the gas being in the Pictured Cliffs formation and not having a source in the coal formation?

A. The assumption is that the gas came from the PC formation or through the PC formation.

Q. Well, but it has its source. In other words, this is Pictured Cliffs gas and only Pictured Cliffs gas?

A. Well, there could be gas that's been injected into the PC formation by virtue of the fracs in the Whiting wells, and I haven't totally discounted that. So that is a potential source of gas.

Q. All right, but have you quantified that?

A. Well, no I haven't. I can't identify the point source in a highly fractured well.

Q. Okay. If your assumption is reversed, though, and the source of the gas that you're using in your calculations of reserves is the Fruitland Coal formation instead of the Pictured Cliffs formation, then you don't have the reserves that you're stating that are in existence in the Pictured Cliff reservoir; isn't that true? I'm just simply asking, if you assume that that's the source instead.

A. If the PC formation were sourced by the coal and that gas resides in the PC formation, then the analysis on the pressure-volume relationship in the PC still holds.

Now, I don't really understand whether you're asking me to say does the P/Z curve work in coal, but if the PC has gas in it, represented by that pressure that we observe in the PC, well, then, that is the gas in the PC.

Q. And you assume that that pressure is also reflective of pressures having a source in the Pictured Cliffs formation, not in the coal?

A. Yes.

MR. GALLEGOS: That's all.

CHAIRMAN WROTENBERY: Any questions?

COMMISSIONER BAILEY: No.

COMMISSIONER LEE: (Shakes head)

CHAIRMAN WROTENBERY: No further questions.

MR. HALL: Nothing further of the witness, thank you.

CHAIRMAN WROTENBERY: Thank you very much, Mr. McCartney.

MR. HALL: Madame Chairman, that concludes our case. I'll not make --

CHAIRMAN WROTENBERY: May I ask one question about the water analysis? Do we have that yet?

MR. HALL: I don't.

CHAIRMAN WROTENBERY: Okay, so you'll submit that?

MR. HALL: I'll have to send that.

CHAIRMAN WROTENBERY: Okay, do that. I'm sorry --

MR. HALL: I surely will.

I was going to say, I'll not make a closing statement tonight. We may file a written closing.

CHAIRMAN WROTENBERY: Yeah, I would really appreciate it if, I guess, both parties would file written closing statements, and we can talk about the schedule for that in a minute.

Do you have --

MR. GALLEGOS: Yes, we have some surrebuttal, and we also want to offer Exhibits W-5 through W-8, which are the well files that were produced by Pendragon. They were admitted previously in the prior hearing, and I think it would be helpful to have the complete file.

CHAIRMAN WROTENBERY: Any objection?

MR. HALL: Subject to inspection, I don't object. As I indicated earlier, the problem we had last year's hearing, that the well files contained some materials that did not come from Pendragon. They included some litigation notes, I assume from Mr. Gallegos' clients. There were foreign materials in there.

CHAIRMAN WROTENBERY: Okay.

MR. HALL: With the exception of those foreign materials, we don't object.

MR. GALLEGOS: Certainly we want Mr. Hall to review them. They were reviewed before, and I think that was correct, and certainly we would offer them and ask that they be admitted subject to his reviewing. And if he thinks there's something in there that's improperly included, it certainly should come out.

CHAIRMAN WROTENBERY: Okay, we'll admit W-5 through W-8, subject to Mr. Hall's review and approval.

And what are we looking at in terms of surrebuttal?

MR. GALLEGOS: Oh, I don't think it will be very long. I want to call Dr. Ayers to straighten out some of the accusations of Mr. Nicol, and I -- That may be it. Probably just Dr. Ayers. I might need to have Mr. Robinson clear up an item or two that came up here.

CHAIRMAN WROTENBERY: Do we need to take a short break now? Yes? Okay, we'll break then until, I guess, 5:40.

(Thereupon, a recess was taken at 5:28 p.m.)

(The following proceedings had at 5:40 p.m.)

MR. GALLEGOS: Dr. Walter Ayers for just a little bit.

DR. AYERS: Still sworn.

CHAIRMAN WROTENBERY: Yes, you've got it down.

WALTER B. AYERS, JR.,

the witness herein, having been previously duly sworn upon his oath, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. GALLEGOS:

Q. Dr. Ayers, I'd like for you to clear up a few things that have been sort of like mudstone, maybe, a little unclear.

The first thing concerns the notion that a Pictured Cliffs sandstone should be laid down in a lagoon, rather than a marine environment.

A. Well, that defies --

Q. Is that what has been offered by Mr. Nicol?

A. That's what has been offered, and it defies all the definitions that I've seen of the Pictured Cliffs sandstone. And a lagoon is simply not equivalent to a littoral shoreline sand deposit. And Mr. Nicol states -- and I can quote his testimony on page 124 of his written testimony, where he says:

The lagoon behind the barrier island...

...on this Figure N-45 ...

...extends about 7 inches westward, and the water is virtually entirely underlain by a lagoonal sheet sand. This is the environment in which the Upper Pictured Cliffs Sand at Chaco was deposited.

And that's a direct quote.

This area, and much of the Texas coastline has been the subject of several environmental atlas studies that were done by the University of Texas Bureau of Economic Geology, and that is not what underlies this lagoon.

Q. Other than Al Nicol on geology, have you found any support for that in the literature, anywhere, or among your colleagues in this field?

A. No, this lagoonal environment is not consistent. It's not consistent in terms of the trace fossils that we described before. The ophiomorpha trace fossil is a littoral trace fossil, it's found over here. You get a scoyenia assemblage back here, rather than a skolithos, which the ophiomorpha belongs to over here. The energy of the environment is different. This area gets highly bioturbated because of the low rates of deposition. In fact, this area is mostly sand and silt in this region.

In fact, this cross-section from McCubbin, after Bernard and others, 1962, is of the Texas Gulf Coast, and you see what he says back here, silt, clay and mixed silt and clay and sand. And permeabilities in this area are generally in the tenths-of-millidarcy range, can be up in the low teens in the millidarcy. But generally not considered reservoir rock.

And also, just geomorphologically, that barrier setting is not a marine environment. And any definition of geomorphology that you find or geology and geology of geological depositional systems, it's just not consistent.

Q. Given that Edwards and Pendragon's ownership of a formation depends not on a pool definition but a formation definition which is, and I quote, limited from the base of the Fruitland Coal formation to the base of the Pictured Cliffs formation, do certain of their wells have perforations that were, until shut in, producing above the base of the Fruitland Coal formation?

A. Yes.

Q. And would you just quickly point those out on your WA-3?

CHAIRMAN WROTENBERY: I'm sorry, did you say what exhibit number about -- that he was talking about? You may have, but I just didn't --

THE WITNESS: It was WA-15.

CHAIRMAN WROTENBERY: Okay, thank you.

MR. GALLEGOS: Thank you, I didn't --

THE WITNESS: No, I had not.

On WA-3, the perforations that are seen in this Fruitland Coal that's above -- excuse me, Fruitland sand, that's above the Pictured Cliffs/Fruitland contact are in the Pendragon Chaco Limited 2-J, the Chaco Number 5, the Chaco 4 and there's shown one in the Lansdale Federal 1, and in the Chaco 1 they show two perfs.

Q. (By Mr. Gallegos) All right. We've now learned in the rebuttal, Dr. Ayers, that you made a mistake concerning the stratigraphic equivalent on the Schneider B Com. Would you clarify that, please?

A. I didn't -- I did not, in my opinion, make a stratigraphic mistake. I said this is a comparable stratigraphic interval in this region, and you can see that we have a thin sand here which at times in the area that we have, it's very thin, as much as just a couple feet thick, and in fact is absent as you go to the southwest of this area.

So individual sands come and go. We're not saying -- When you're talking about stratigraphic equivalency, we're not saying you have the same individual beds in one area as in the other. We're just saying that relative to the boundaries, these beds -- or relative to one another in terms of geologic setting, block stratigraphic units, that these are in the same stratigraphic sequence.

Q. And is that the very basis for the delineation and definition of the Fruitland Coal formation that's employed by the OCD in Order R-8768?

A. That's my understanding, that they adopted the coalbed methane committee's recommendations that were based upon this type log.

Q. Do you have that exhibit that was the log on the Chaco 2-R?

A. The log on the Chaco 2-R.

Q. That's what I want --

A. Yes.

Q. Oh, you have that?

A. I have it back at my desk.

Q. Okay, because I just wanted to ask you a question about that, where we learn now that you misread the --

A. Let me get it. I have one back here.

Q. Okay, the question is, will you respond to the allegation that you've misread the -- believe you misread the sandstone on that log?

A. I can make mistakes and I have made mistakes, but this is not one of them. I've read a lot of logs, and this is consistent. On the Chaco 2-R, Mr. Nicol, in his map, Exhibit N-50, at the Chaco 2-R well, has a zero value for this sand which he refers to as upper Pictured Cliffs, that I refer to as the Fruitland sand.

But if you look at the log in that stratigraphic interval --

Q. It's not going to be visible --

A. I'm sorry.

Q. -- to the Commission from that distance.

A. In this interval there is a -- responses to the pore log on the SP side, but --

Q. What exhibit number is that, Dr. Ayers?

A. I don't know which --

Q. Let me see, it's got the exhibit number on here. Robinson-2.

A. There is a very small spike there that's representative of that thin sand, or one in that interval near the -- job. So stratigraphically, if you're mapping the extent of that unit, it doesn't stop when it's no longer -- as a reservoir-perforable interval. It's still there, and it's still something that you map. So when you're mapping it geologically, you want to map it to show what the extent of the system is and the energy in the system.

And so what I noticed on several of the logs, when you got over here where the sand in that interval was thin on this map, comparing it to mine, there was a zero value where I would have a couple of feet of sand.

So this map, Mr. Nicol's, and my map, my WA-10, were used to make this as a composite map. And when I did the overlay on the numbers, as I said, I noticed the differences. And so, where Mr. Nicol had a zero value right here in the Chaco 2-R, I had two feet of sand.

You'll notice that in Exhibit N-50-1-A [*sic*] there are a few places where there are zeros, but I have contoured through some sand. Some of those are those places, and the technician didn't put both values. The technician was supposed to put Mr. Nicol's and my values in different colors, and this was finished after I came here and express-mailed to me, so I didn't get to correct that.

But these zeros here were places where either I had a value that disagreed with Mr. Nicol, or he had a -- in these two cases here, he had a zero. I didn't have a log, but it didn't differ from what I saw around it, and I knew he tended to ignore the thin sand, which the sedimentologist suggested was probably there. Those zeros may or may not be wrong in -- or right, in a couple of cases.

But in most cases what I found was that he tended to ignore the sand when it got down to a two-foot or so limit.

MR. GALLEGOS: Thank you, Dr. Ayers, that completes my questions.

CHAIRMAN WROTENBERY: Mr. Hall?

CROSS-EXAMINATION

BY MR. HALL:

Q. Dr. Ayers, with respect to the log on the Amoco Schneider well, is the lowermost thin sand you pointed out on that log a chronostratic [*sic*] equivalent with what we see in the WAW area?

A. Is it a chronostratigraphic? We're not talking here -- We're talking lithostratigraphy.

Q. Yes, my question to you was, it is a chronostratigraphic equivalent?

A. I'm sorry, what is?

Q. The lowermost thin sand you pointed out on the Schneider B Com log.

A. Is what?

Q. With -- Is there a chronostratigraphic equivalent with what you see in the WAW field?

A. No.

Q. Can you tell us how many million years' time difference there is in the -- from the Schneider B Com sand you show and what's seen in the WAW field?

A. No, I can't tell you exactly. There have been some estimates in a recent paper by Fassett and I believe it was Stein or Steiner. Several -- around 10 to 15 or 30 million years -- no, I think it was 10 to 15. I don't recall. It's not really material to this hearing.

Q. I see. I understood your testimony just now was 10 to 15 to 30 million years' difference?

A. Somewhere -- No, it was more like 10 to 15, but it's immaterial to what we're talking about here. Chronostratigraphic units have nothing to do with the definition of rock stratigraphic units.

Q. Dr. Ayers, isn't the upper Pictured Cliffs sand a transgressive event of a beach sand moving into a lagoonal setting?

A. Not necessarily.

Q. Well, can't ocean sands or beach sands like that be carried into a marine lagoon during a storm event or an instatic sea-level rise?

A. No, there aren't any marine lagoons.

Q. I'm not sure you answered my question.

A. I answered your question. You asked me if the sand would be carried into a marine lagoon, and I said there are no marine lagoons.

Q. Oh, I understand what you mean. Isn't it possible, though, that an ocean sand or a beach sand can be carried into a lagoon by a hurricane event, some major storm event?

A. That's what's called a washover fan, yes.

Q. All right. And aren't washover fans, sands deposited in a washover sand like that, aren't they marine sands?

A. No, they are back barrier sands by definition.

Q. Can you put your Exhibit WA-15 up for us again, please, sir?

Using that exhibit, in the event of a rise in the sea level, can you show us how a barrier bar might shift towards a landward position? Can you do that?

A. Not very easily. I can try, but you probably won't understand it. I'd have to draw it on the board.

Q. Well, this is for the Commissioners to understand.

A. They might get it. Okay, this may take me a half hour to draw.

Q. Well, let's not take that long.

A. In the example that's shown here I tried to show, but not very well, that as the shoreline is building out, as we're prograding the shoreline, and this would be building seaward, or in the case of the San Juan Basin Pictured Cliffs, it was building out to the northeast.

And so we have a sea floor out here. Here's the littoral environment where the wave action is breaking and depositing the sands of the Pictured Cliffs formation.

Over here is shelf silt and sand marine bars.

Back here we have the silts, clays of the lagoon and some washover fan deposits -- which we could do in a different color, I suppose -- which would be carried back into the lagoon at the flood stage.

MR. GALLEGOS: Is this -- Doesn't this illustrate his drawings?

THE WITNESS: Yeah, that's essentially where we are with progradation and building out of the shoreline.

Now when you have a transgression, what happens is -- it depends on -- it can vary with different parts of the shoreline, but if it is in this area and this shoreline remained active and had an active source of sediments, this would work back -- I think I described this yesterday, the whole shoreline would come back. And it's called retrogradation. It would simply work its way back up over this. It would look similar to this, but coming back inland, to the southwest.

I could -- What you would end up with, then -- and that's what I say, it's really hard to draw, is all these environments start shifting up and backward. But what will happen, then, is that you will get everything coming back landward, over the top of these pre-existing basins.

But at the same time, the reason it's hard to draw is that at the same time this is happening, either sea level is rising or the floor of the basin is subsiding.

What you end up with, if I can just simplify, say that you have something like this where this was the coastal sand going like this, with the continental deposits behind it, which are the Fruitland formation, and below this would be the marine Lewis shale, which was out here.

And so you get this sequence like this, with all this being shale. Then if it reverses, this comes back across like this. So you have a zig-zag effect of shoreline moving in and out.

In some cases, if the supply of sediment is cut off, you may get erosional surfaces and a hiatus and no deposition. You may get a blank spot in here instead of having this shoreline sand that -- back and forth, you get an erosional surface there or a surface of nondeposition.

I know that's not very clear, but -- I apologize. It's a difficult thing to draw.

Q. (By Mr. Hall) Dr. Ayers, when you take a walk, start at the beach and start walking landward, at what point do the sands cease being considered a marine sand?

A. A marine sand?

Q. Right.

A. Well, in this case the marine sand, the part that's in the littoral zone, on the sand log here, is right here in the shore face. Now, the beach -- the dunes and the beach shore face, I should say foreshore here, the berm is back here, and then you usually get barrier ridges. If you have that, this is all sourced from the beach, because the wind blows the sand off the beach and piles it up in the dunes. That becomes part of a barrier complex, but it is not part of the marine deposition.

MR. HALL: Thank you, Dr. Ayers, appreciate the courtesy.

CHAIRMAN WROTENBERY: Commissioner Lee?

COMMISSIONER LEE: (Shakes head)

CHAIRMAN WROTENBERY: Thank you, Dr. Ayers.

THE WITNESS: Thank you.

MR. GALLEGOS: So much fun I hate to end it, but I have one question for Mr. Robinson.

CHAIRMAN WROTENBERY: Okay.

<u>BRADLEY M. ROBINSON</u>,

the witness herein, having been previously duly sworn upon his oath, was examined and testified as follows:

DIRECT EXAMINATION

BY MR. GALLEGOS:

Q. Mr. Robinson, witness Cox alleged that instead of using initial shut-in pressure -- I'm talking about the injection test that we heard so much about --

A. Right.

Q. -- instead of using initial pressure of 70 p.s.i. and -- I think I have these right -- 70 p.s.i. --

A. Yeah, 70.15 or something like that.

Q. -- you used 94.

A. Roughly 94, yes.

Q. 94. And that would make a significant difference on your permeability valuation on your test. Would you clarify that allegation for the Commission?

A. Yes. I just want the Commission to realize that that doesn't change the permeability number at all. In fact, the first time I analyzed that test I used the 70 p.s.i., and I got the exact same permeability, 248 millidarcies or something like that. The early time data looked very unusual, and so I showed it to our Dr. John Lee and he said, You need a zero-time correction. So that's why we made the zero-time correction.

Did not change the permeability one bit. The only thing it changed was the skin factor, and that would be the only thing it would change.

The same thing with this criticism of my Langmuir pressure. You can turn off the coal feature on any one of those analyses, you get the exact same permeability. So it doesn't matter what Langmuir pressure you use. It only affects skin factor, next to the wellbore.

So I just wanted the Commission to understand, it does not change the permeability.

MR. GALLEGOS: That's all.

MR. HALL: I have no questions.

CHAIRMAN WROTENBERY: One question, sorry.

EXAMINATION

BY COMMISSIONER LEE:

Q. What you're saying is, your type curve is moving up and down in the later stages?

A. Skin only.

Q. But the shape is the same?

A. Exactly.

Q. I have another problem, though -- not a problem. Do you know the range you used to analyze the permeability, the ΔP change? Twenty hours? Twenty-seven hours? Only 2 to 3 p.s.i. --

A. During the --

Q. During the later change.

A. Oh, the falloff?

Q. Yes.

A. Yes, sir.

Q. That's where you get your permeability?

A. I'm not talking about the falloff analysis. This is only the early injection part of the test, when we inject gas and we're measuring the pressure increase, and then it rolls over and breaks over sort of -- it's analogous to sort of a Horner plot, pressure buildup --

Q. But your permeability is from a later stage, because the initial stage, you don't use it, right?

A. The permeability is only calculated from the late time transient vehicle --

Q. And --

A. -- yes, sir.

Q. -- I know that it doesn't affect the skin factor at all?

A. Exactly.

Q. But then I have another problem, is, the pressure change is very small during that time.

A. Yes, it is very small, because the reservoir is very permeable. That's exactly what you would expect, a very small pressure change.

CHAIRMAN WROTENBERY: Did you want to add anything, Mr. Gallegos?

MR. GALLEGOS: Nothing further.

CHAIRMAN WROTENBERY: Okay.

MR. GALLEGOS: All right, that's it.

CHAIRMAN WROTENBERY: Great.

MR. GALLEGOS: I'm sure you don't want to hear arguments of counsel now. If you could set some kind of a schedule now. If you set some kind of a schedule where we can either submit an order or whatever you would like, Madame Chairman.

CHAIRMAN WROTENBERY: That sounds good. I talked to Mr. Brenner briefly, and his estimate is it will be probably eight weeks before the transcript will be available, so that will be -- I was just looking at that on the calendar -- about October 15th, eight weeks from today.

How long after the transcripts are available would it take for you to prepare a written closing statement and a --

MR. CONDON: -- and a proposed order.

CHAIRMAN WROTENBERY: -- and a proposed order?

MR. CONDON: Okay.

MR. GALLEGOS: Thirty days, do you think?

CHAIRMAN WROTENBERY: Thirty days?

MR. HALL: That sounds right, try to get it in before that.

MR. CONDON: That's very good. You usually say ten days.

(Laughter)

MR. CONDON: We can get this done in two weeks, and then you'd assign it to me, the task of doing the first draft. We're making some progress. About 30 days I think is realistic.

CHAIRMAN WROTENBERY: Okay, that puts it mid-November. Maybe we can just make it the end of the week of the 15th, so that would be November 19th.

MR. CONDON: Okay.

CHAIRMAN WROTENBERY: That's the week before the

Thanksgiving holidays, to probably go ahead and get that done.

MR. CONDON: Sure, get it out of the way. Yes.

CHAIRMAN WROTENBERY: Okay. And --

MR. GALLEGOS: Would you want us to -- give us a page limit on the written statements or something --

MR. HALL: I think that's a good idea, Mr. Gallegos.

MR. GALLEGOS: I think it is a good idea.

CHAIRMAN WROTENBERY: Yeah, that's a good idea. What would you suggest?

MR. HALL: Ten.

MR. GALLEGOS: I was going to say twenty, but -- There's a lot of testimony here.

CHAIRMAN WROTENBERY: Twenty pages sounds reasonable, I think.

MR. HALL: You asked for it.

CHAIRMAN WROTENBERY: Okay.

MR. CONDON: We'll double-space.

MR. HALL: No exhibits.

CHAIRMAN WROTENBERY: Okay. Any other questions about the timing or what's expected?

I do want to remind everybody, let's see, we still need BR-30 and BR-26 (a) from Whiting and Maralex in a --

MR. CONDON: In an 8-1/2-by-11 format?

CHAIRMAN WROTENBERY: -- in an 8-1/2-by-11 format. And we still need N-A from Pendragon and the water analyses.

MR. HALL: Yeah, which we've called T-A, so --

CHAIRMAN WROTENBERY: T-A.

MR. HALL: -- so we'll get those.

MR. CONDON: Oh, and Mr. Thompson had agreed to provide his well-report file for the -- indicating the well-report forms that he was using during 1995 and 1998 that included a water calculation and also whatever he had for the coal wells that were on that one exhibit. The Cowsaround 21-1 is the one I remember.

MR. HALL: He wanted an exemplar form, as I understand it, so we'll provide that form. I don't know -- Are we making that part of the record? It seems like we're not.

MR. GALLEGOS: Well, let's wait and see --

CHAIRMAN WROTENBERY: Okay --

MR. GALLEGOS: -- get it and see whether --

CHAIRMAN WROTENBERY: -- and then we'll --

MR. GALLEGOS: -- that's significant.

CHAIRMAN WROTENBERY: Okay.

MR. GALLEGOS: We can late-file it if we --

CHAIRMAN WROTENBERY: That will be fine.

MR. GALLEGOS: -- if we need to. Thank you.

MR. HALL: Oh, and I had understood that we'd be provided with the pressure data from the first injection falloff test that Mr. Robinson and Maralex had done.

CHAIRMAN WROTENBERY: Okay, I was thinking that was the material that had been discarded or --

MR. HALL: Well, I had understood that the data --

MR. GALLEGOS: No.

MR. HALL: -- was still available.

MR. GALLEGOS: No, no.

CHAIRMAN WROTENBERY: Oh, the data.

MR. GALLEGOS: I think discarded just in the sense that it wasn't used to make an analysis, but the data is --

CHAIRMAN WROTENBERY: -- still there.

MR. GALLEGOS: Yeah.

CHAIRMAN WROTENBERY: Okay, okay. But that's something you will exchange between yourselves?

MR. HALL: Yeah.

MR. GALLEGOS: Sure.

CHAIRMAN WROTENBERY: Okay. Can you think of anything else? Lyn, can you think of anything else that we need to address?

(Off the record)

CHAIRMAN WROTENBERY: I think that's all we need to do, then.

Oh, Mr. Hall?

MR. HALL: I would like to say thank all of you very much for listening to this case. We appreciate the patience and the time you've put in on it, so thank you all.

CHAIRMAN WROTENBERY: Well, thank you for bearing with us on Saturday so we could get through it all. We really appreciate that. Special thanks to your daughter for doing without you today.

MR. GALLEGOS: I'll tell her, but I don't think it will be very --

CHAIRMAN WROTENBERY: I know, but for what it's worth.

MR. CONDON: She called me to see if I could represent her.

CHAIRMAN WROTENBERY: Okay. Thank you, everybody, very much.

MR. CONDON: Thank you.

CHAIRMAN WROTENBERY: And the meeting is adjourned.

(Thereupon, these proceedings were concluded at 6:10 p.m.)

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CERTIFICATE OF REPORTER

STATE OF NEW MEXICO)
) ss.
COUNTY OF SANTA FE)

I, Steven T. Brenner, Certified Court Reporter and Notary Public, HEREBY CERTIFY that the foregoing transcript of proceedings before the Oil Conservation Commission was reported by me; that I transcribed my notes; and that the foregoing is a true and accurate record of the proceedings.

I FURTHER CERTIFY that I am not a relative or employee of any of the parties or attorneys involved in this matter and that I have no personal interest in the final disposition of this matter.

WITNESS MY HAND AND SEAL September 30th, 1999.

STEVEN T. BRENNER
CCR No. 7

My commission expires: October 14, 2002